CITY OF NEW HAVEN LONG-TERM CSO CONTROL PLAN

TECHNICAL MEMORANDUM #12

Preliminary Evaluation of CSO Control Alternatives

Prepared for

The City of New Haven
The New Haven Water Pollution Control Authority

Prepared by

CH2MHILL

50 Staniford Street, 10th Floor
Boston, MA 02114

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List of Acronyms

BOD	Biochemical Oxygen Demand
BMP	Best Management Practice
CSO	Combined Sewer Overflow
CTDEP	State of Connecticut Department of Environmental Protection
EPA	Environmental Protection Agency
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
WPAF	Water Pollution Abatement Facility
WPCA	Water Pollution Control Authority

Introduction

Project Background

The City of New Haven and the New Haven Water Pollution Control Authority (WPCA) operate a wastewater collection and treatment system which serves over 100,000 residents in the City of New Haven, and through interlocal agreements, the Towns of Woodbridge, Hamden, and East Haven (East Haven accepts some wastewater flow from North Branford). A map of the area is provided in Figure 1.

New Haven's wastewater collection system contains two types of sewers" combined sewers and separate sewers. In neighborhoods served by combined sewers, a single pipe collects both sanitary sewage and stormwater runoff. In neighborhoods served by separate sewers, two pipes are used: one to collect sanitary sewage and a second to collect stormwater runoff. During dry weather, New Haven's sewer system transports a combination of sanitary flow and groundwater infiltration to the 40 million-gallon-per-day (mgd) East Shore Water Pollution Abatement Facility (WPAF). All dry weather flows receive secondary treatment and disinfection at the WPAF prior to discharge to the New Haven Harbor. During wet weather, large quantities of stormwater enter the combined sewer system. As a result, portions of the system may become overloaded, and combined sewage overflows to the receiving waters. The system has approximately 258 miles of sanitary/combined sewers, 25 combined sewer overflow (CSO) regulators (which divert high flows from the interceptor sewer to a CSO outfall), and 21 CSO outfalls (CH2M HILL, June 1998). Figure 2 is a schematic diagram showing how a combined sewer system works during wet weather.

Figure 2 Typical Combined Sewer System

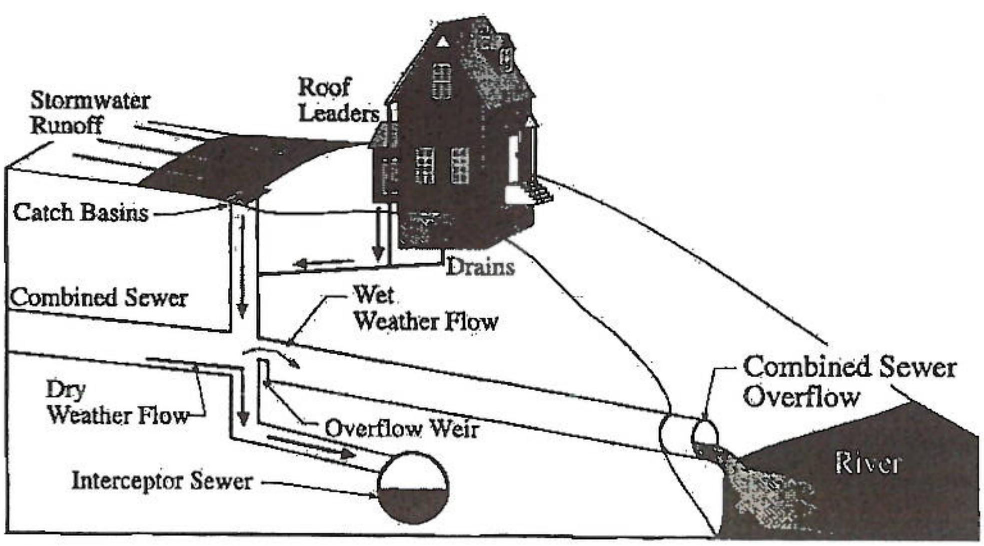
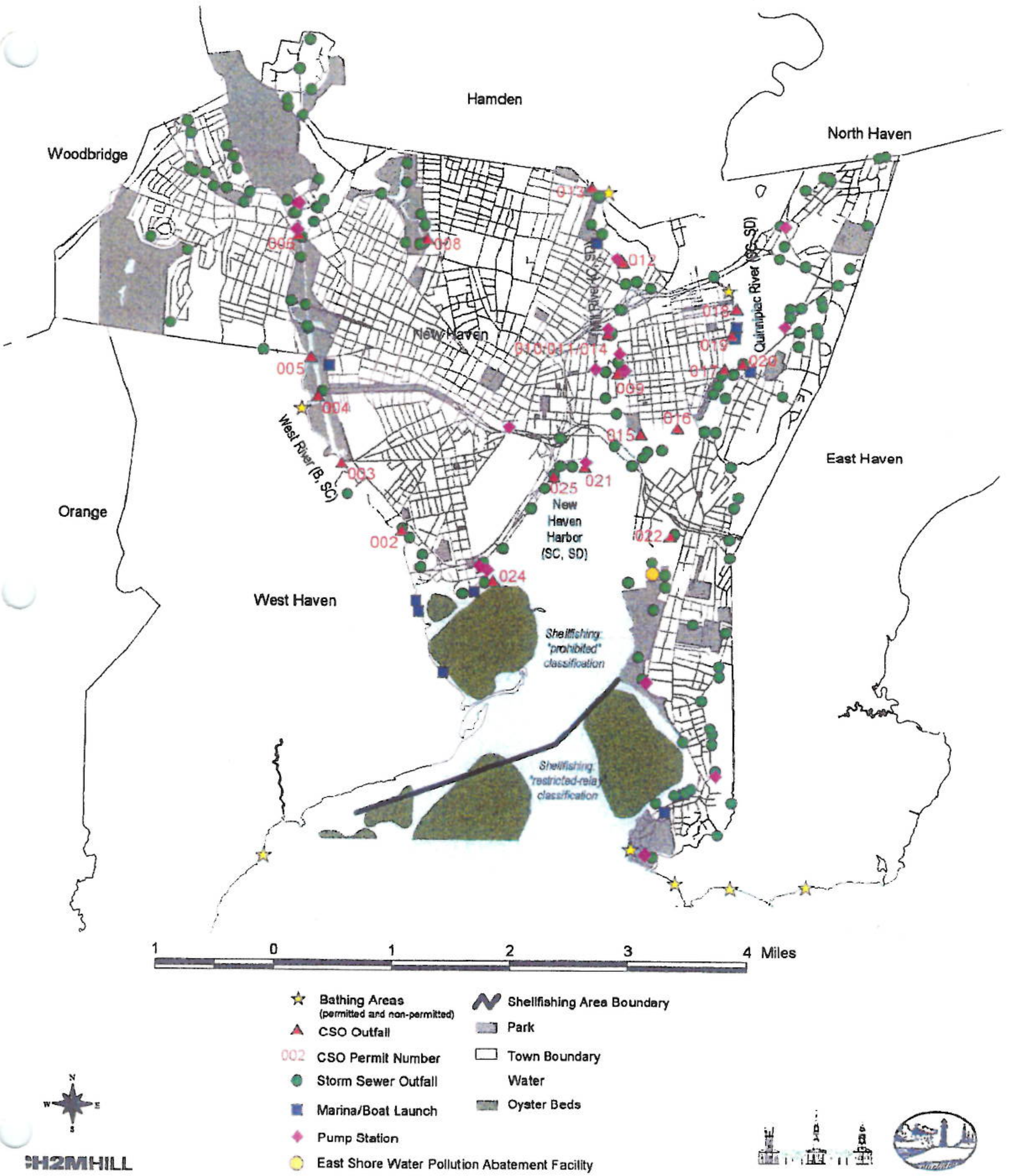


Figure 1
New Haven Long Term Control Plan Study Area



CH2MHILL

A facility plan, which evaluated alternative methods for controlling CSOs, was completed in 1981 and updated in 1988. The plan evaluated controls required to convey, treat, or store overflows associated with a 10-year storm. The plan concluded that sewer separation was the most cost-effective method of meeting the evaluation criteria. Approximately 35 percent of the planned sewer separation is complete (CH2M HILL, July 1997). Because of the significant advancements in regulatory requirements and technological issues, the city has decided to reevaluate this approach.

Project Objectives

In 1997, the City of New Haven entered into an agreement with CH2M HILL to prepare a Long Term CSO Control Plan. The objectives of this project as defined in its scope of work include the following:

- Reduce the overall cost of constructing CSO controls
- Produce documents required for CSO-related issues described in the WPCA's National Pollutant Discharge Elimination System (NPDES) Permit administered and enforced through the State of Connecticut Department of Environmental Protection's (CTDEP) Permitting, Enforcement, and Remediation Division, Water Management Bureau (CTDEP, 1994)
- Produce a long-term CSO control plan which, in general, is consistent with guidance provided in the Environmental Protection Agency (EPA) CSO Control Policy of April 1994

These project goals were reviewed and expanded for the CSO control technology evaluation process in Task 6, Evaluation of CSO Control Alternatives. A Stakeholder Group was assembled consisting of representatives from city government plus local, regional, state, and federal regulatory agencies and environmental groups to provide input into the CSO control technology evaluation process. Representatives committed to attending a series of meetings where their input would be solicited and discussed. Steps included:

- Educating the group on wastewater collection and treatment practices
- Developing and prioritizing goals for the project
- Developing and prioritizing CSO control technology evaluation criteria
- Applying evaluation criteria
- Reviewing results
- Responding to questions provided by the group

This process and the results of this process are a principal subject of this report and is described in greater detail in later sections of this report. Additional information is also available in a loose-leaf binder entitled *City of New Haven Long-Term Combined Sewer Overflow Control Plan, Project Information for Stakeholders* (CH2M HILL, August 1998) which is updated with meeting materials as meetings occur.

Tasks of the project and their current status are presented in Table 1.

TABLE 1 Project Tasks and Status

Task	Current Status
Task 1: Establish Project Goals and Approach	Done
Task 2: Model Development	Done
Task 3: Monitoring Program	Done
Task 4: Hydraulic Characterization	One-half done
Task 5: Nine Minimum Controls	One-half done
Task 6: Evaluation of CSO Control Alternatives	Done
Task 7: Design Development	Not started
Task 8: Long Term CSO Control Plan	Not started

Purpose of this Report

The purpose of this report is to document work performed under Task 6, Evaluation of CSO Control Alternatives. In addition to formation of a Stakeholder Group to provide input to the decision-making process, the purpose of Task 6 included the following:

- Identify a broad list of CSO control technologies
- Develop an evaluation process
- Develop evaluation criteria
- Evaluate CSO control technologies
- Develop a short-list of technologies
- Formulate additional alternatives by grouping select technologies

This report presents the results of the work performed and outlined above. Task 7, Design Development, will further evaluate the application of each of the short-listed technologies and the grouped alternatives by receiving water: West River, Mill River, Quinnipiac River, and New Haven Harbor. Costs and benefits of applicable technologies and alternatives will also be developed as part of Task 7 and reviewed with the Stakeholder Group and public. Final recommendations for CSO control will then be presented.

CSO Control Technologies

There are numerous available technologies and approaches to CSO control. The technologies have different characteristics and can meet a wide range of water quality objectives at varying costs. Selection of the most appropriate CSO control technologies for the City of New Haven combined sewer service area depends on local conditions and evaluation criteria. CSO control technologies can be grouped into five general classifications:

- Sewer system optimization
- Source controls
- Inflow reduction techniques
- Treatment
- Storage

Control technologies within each classification are discussed in the following section. A summary of the advantages and disadvantages of each control technology is presented in Appendix A.

These control technologies focus on long-term CSO control, which is defined as CSO controls that typically achieve higher levels of CSO control due to increased design and permitting complexity and length of time to implement. A separate report, *Nine Minimum Controls* (CH2M HILL, June 1998), presents data and recommendations for short-term CSO controls.

Sewer System Optimization

Sewer system optimization refers to controls that operate in the existing combined sewer system. Sewer system optimization techniques use various levels of in-system flow control to enhance temporary storage or transport of wet-weather flow directly to the East Shore WPAF. The goal of sewer system optimization projects is to decrease overflows with minimal major structural additions or modifications. Sewer system optimization projects are required under the EPA CSO Control Policy's Nine Minimum Controls (NMCs) which includes optimizing sewer system conveyance and maximizing flows to the WPAF. Task 5 of the New Haven Long-Term CSO Control Project focuses on review and compliance with EPA's NMCs. Task 5 is approximately half complete, and a report entitled *Nine Minimum Controls* (CH2M HILL, June 1998) presents Task 5 results to date. The remainder of Task 5 will be completed once computer modeling results of the sewer system have been approved. Task 5 results will form the foundation of the New Haven *Short*-Term CSO Control Plan.

The primary forms of sewer system optimization are:

- Improve or retrofit sewer system with static-flow control (passive CSO regulators)
- Improve or retrofit sewer system with variable-flow control (active CSO regulators)
- Retrofit sewer system with real-time control

A description of the sewer system optimization technologies and their advantages, disadvantages, and applicability are discussed in fact sheets in Appendix A.

Source Controls

Source controls are characterized by nonstructural techniques. The technologies, often referred to as best management practices (BMPs), reduce pollutant loading by intercepting or preventing the accumulation of contaminants before they enter the overflow stream. Because they operate on selected pollutant sources and not on the overflow stream, source controls may not reduce the frequency, volume, or duration of CSO; however, the pollutant concentrations associated with the overflow are reduced. Some source controls include:

- Street sweeping
- Combined sewer flushing
- Catch basin cleaning, and if possible, retrofitting with hoods

A description of the source control technologies and their advantages, disadvantages, and applicability are discussed in fact sheets in Appendix A.

Inflow Reduction Techniques

Inflow reduction techniques are CSO control options that reduce the amount of surface runoff entering the combined sewer system. Subsequently, overall hydraulic loading is reduced, diminishing the frequency, volume, and duration of CSO. Examples of this form of control include:

- Upstream stormwater storage
- Flow slippage
- Sewer separation

A description of the inflow reduction techniques and their advantages, disadvantages, and applicability are discussed in fact sheets in Appendix A.

Treatment

Treatment systems provide physical-chemical treatment of the overflow stream before discharge to the receiving water. Methods and facilities for physical-chemical treatment of the overflow stream includes:

- Nets (in-line and end-of-pipe netting)
- Screens (microscreens, mechanical screens, and coarse screens)
- Swirl concentrator and vortex separator
- Gravity sedimentation (primary treatment)
- Flocculation and sedimentation
- High-rate filtration
- Chlorination/Dechlorination
- Treatment at East Shore WPAF

A description of the treatment technologies and their advantages, disadvantages, and applicability are discussed in fact sheets in Appendix A.

Storage

Storage and treatment systems are structural controls that provide end-of-pipe treatment to the overflow stream before discharge to the receiving water. Because of the highly variable nature of CSO, storage is often a major component of such systems. CSO control systems that store the overflow stream before treatment and discharge include the following:

- Closed concrete tanks
- Storage conduits
- Storage tunnels

A description of the storage technologies and their advantages, disadvantages, and applicability are discussed in fact sheets in Appendix A.

CSO Control Technology Evaluation Process

The CSO control technology evaluation process included developing a stakeholder group to review information and to provide input to the process. Stakeholders are from a variety of city offices, state and federal regulatory agencies, and environmental and public interest groups as shown in Table 2.

TABLE 2 New Haven CSO Long-Term Control Plan Stakeholder List

Organization	Name
City of New Haven / Board of Aldermen	Raul Avila
City of New Haven / Board of Aldermen	David Moakley
City of New Haven / Engineering Department	Richard Miller
City of New Haven / Engineering Department	Larry Smith
City of New Haven / Environmental Advisory Council	Ed Grant
City of New Haven / Health Department	William Quinn
City of New Haven / Parks Department	Pam Kressmann
City of New Haven / Parks Department-Riverkeeper	Peter Davis
City of New Haven / Planning Department	Joy Ford
City of New Haven / Water Pollution Control Authority	Raymond Smedberg
CT DEP Bureau of Water Management / Municipal Facilities	William Hogan
CT DEP Long Island Sound Program	Susan Gradante
CT DEP Marine Fisheries	Ernie Beckwith
CT DPHS Bureau of Aquaculture	John Volk
CT Fund for the Environment	Donald Strait
Long Island Sound Keepers Fund / CT Aquaculture Association	Terry Backer
Natural Resources Defense Council	Peter Lehner
Quinnipiac River Watershed Association	Sigrund Gadwa
US EPA-Region I	Michael Fedak
US EPA / Long Island Sound	Mark Tedesco
West River Watershed Association	Duncan Schmitt
Yale University / Center for Coastal and Watershed Systems	Emly McDiarmid

The CSO control technology evaluation process followed a decision-making process outlined in the following graphic:

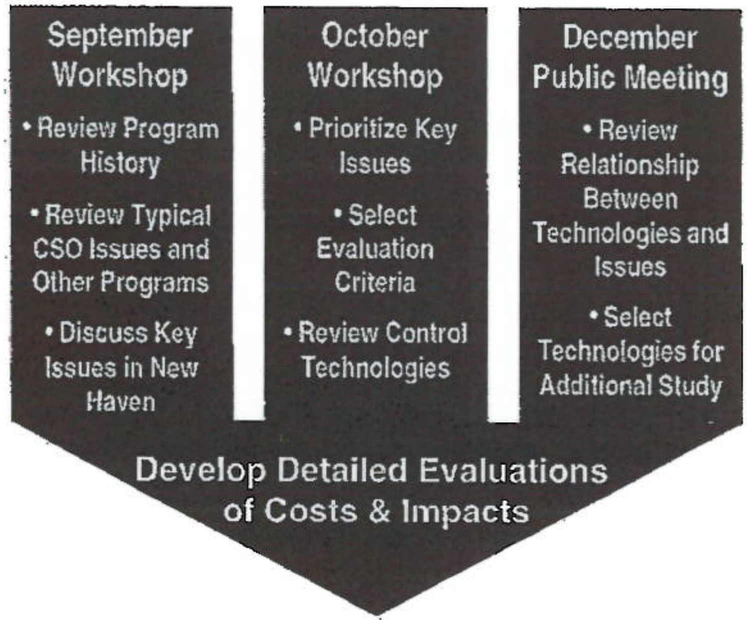


FIGURE 3. Overview of Decision Making Process

Two stakeholder meetings plus one joint stakeholder and public meeting have been held to gain input to the evaluation process on the following dates: Thursday, September 17, 1998; Tuesday, October 13, 1998, and Tuesday, December 8, 1998. Minutes from these meetings have been sent out to all of the stakeholders and meeting attendees. Copies are also provided in Appendix B. Results of the meetings are presented below.

September 17th Stakeholder Meeting

During the September 17th meeting, stakeholders met to discuss their primary interests regarding CSO control in the City of New Haven. After expressing their interests, they were asked to develop a comprehensive list of stakeholder concerns, categorized under six main headings. The following categories formed the basis for a group brainstorming session in which participants added to and refined their original ideas:

- System performance
- Regulatory
- Receiving water
- Cost
- Public involvement/acceptance
- Other

After developing their comprehensive list of concerns, stakeholders were then asked to identify their top three concerns out of the list of 34. In this exercise, each participant placed a dot sticker on a chart next to the topics that most concerned them. These included the following top interests:

- Focus on improving water quality in critical areas
- Focus on improving water quality for specific uses like shellfishing, fishing, swimming, boating, recreational uses, wildlife, wetland (tidal, inland)
- Optimize performance of existing facilities including treatment plant capacity
- Balance costs and benefits
- Improve aquatic habitat

The outcome of this informal polling formed the basis for the more detailed, refined evaluation criteria development during the next stakeholder meeting.

October 13th Stakeholder Meeting

At the October 13th meeting, stakeholders reviewed their general list of concerns from the September meeting. They discussed each of the concerns in some detail to ensure common understanding of the development of each evaluation criterion. Once they agreed that these criteria met their expectations for a fair, impartial evaluation, stakeholders then expressed their comparative preferences for the evaluation criteria through a prioritization scoring exercise. In this way, stakeholders have worked to determine not only the criteria themselves, but the relative importance of each criteria for use in the CSO control evaluation model. The results of the evaluation criteria prioritization are presented as Table 3.

As shown in Table 3, the top evaluation criteria identified are:

- Meet State water quality standards
- Protect critical areas
- Eliminate dry and wet weather overflows
- Maximize aquatic habitat
- Maximize conveyance
- Maximize treatment plant capacity

These top evaluation criteria closely match the top concerns of the September 17th meeting, however, costs rank considerably lower as evaluation criteria than as a concern after the discussions during the October 13th meeting.

December 8th Public/Stakeholder Meeting

The stakeholder discussion and feedback from the two previous meetings led to the development of a detailed alternatives evaluation model. At the December 8th meeting, CH2M HILL representatives presented the results of the CSO control evaluation model. An evaluation scale was developed by CH2M HILL for each criterion to establish a quantifiable basis for comparing the performance of each CSO control technology. The evaluation scale, presented in Table 4, was developed from industry-standard information on the various CSO control technologies gathered over the past 10 years of performing CSO control technology evaluations (CH2M HILL 1991). More detailed evaluation of the technologies on a site-specific basis will occur as part of Task 7.

TABLE 3 CSO Control Evaluation Criteria Prioritization

			Score[1]		Rank
Water Quality	Meets State WQ standards (bacteria, DO)		88		1
Water Quality	Minimize solids		66		14
Water Quality	Minimize floatables		68		13
Water Quality	Minimize metals		65		15
Water Quality	Minimize nutrients		70		10
System Performance	Maximize conveyance		75		6
System Performance	Maximize treatment plant capacity		73		7
System Performance	Eliminate dry weather overflows		81		3
System Performance	Eliminate wet weather overflows (CSOs)		81		3
Public Acceptance	Maximize recreational use		72		9
Public Acceptance	Maximize aquatic habitat		76		5
Public Acceptance	Minimize public complaints		56		19
Public Acceptance	Minimize time for improvements		69		11
Cost	Minimize capital costs		62		16
Cost	Minimize operation and maintenance (O&M) costs		59		17
Environmental Impacts	Protect wildlife		73		7
Environmental Impacts	Protect critical areas		86		2
Community Impacts	Clean streets		52		19
Community Impacts	Maximize associated public improvements		37		20
Community Impacts	Maximize local park improvements		54		18
Community Impacts	Eliminate sewer backups		69		11

1 Mean values; 0-100 scoring scale; maximum = 100

CSO control technologies were then evaluated based on the criteria and prioritization from stakeholders. Details of the evaluation are provided in Table 5. Results of the evaluation process, presented as Figure 4, identified the following technologies as meeting the mix of evaluation criteria best:

- Upland stormwater storage
- Below ground CSO storage
- Treatment plant modifications

Results of the Alternatives Evaluation

Technologies were grouped and re-evaluated to determine if there were added benefits to combining a storage and treatment technology together. This grouping was based on a

TABLE 4 CSO Control Evaluation Criteria Prioritization and Evaluation Scale

Category	Criteria	Score[1]	Rank	Evaluation Scale
Water Quality	Meets State WQ standards (bacteria, DO)	88	1	0% bacteria removal 0 points 0%<x<90.0% 1 90.0%</=x<99.0% 5 99.0%</=x<99.9% 7 x=/>99.9% 10
Water Quality	Minimize solids	66	14	All parameters: 0% pollutant removal 0 points 0%<x</=10% 1 10%<x</=20% 2 20%<x</=40% 4 40%<x</=60% 6 60%<x</=80% 8 80%<x</=100% 10
Water Quality	Minimize floatables	68	13	
Water Quality	Minimize metals	65	15	
Water Quality	Minimize nutrients	70	10	
System Performance	Maximize conveyance	75	6	Yes = 10 points; No = 0 points
System Performance	Maximize treatment plant capacity	73	7	Yes = 10 points; No = 0 points
System Performance	Eliminate dry weather overflows	81	3	Yes = 10 points; No = 0 points
System Performance	Eliminate wet weather overflows (CSOs)	81	3	% Reduction in CSO Volume: 0% reduction 0 points 0%<x</=10% 1 10%<x</=20% 2 20%<x</=40% 4 40%<x</=60% 6 60%<x</=80% 8 80%<x</=100% 10
Public Acceptance	Maximize recreational use	72	9	Significant Net Env. Benefit 10 points Positive Net Env. Benefit 5 Very Positive Net Env. Benefit 7.5 Little or No Net Env. Benefit 0
Public Acceptance	Maximize aquatic habitat	76	5	
Public Acceptance	Minimize public complaints	56	19	Incorporated under other criteria
Public Acceptance	Minimize time for improvements	69	11	0 time<x</= 0.5 years 10 points 0.5 years<x</=1 year 9 1 year<x</=3 years 8 3 years<x</=5 years 6 5 years<x</=10 years 4 10 years<x</=20 years 2 20 years<x 0
Cost	Minimize capital costs	62	16	x= $1/1000gal 10 points $1<x</=$5/1000gal 9 $5<x</=$10/1000gal 7 $10<x</=$25/1000gal 4 $25<x</=$50/1000gal 2 $50/1000gal<x 0
Cost	Minimize O&M costs	59	17	x= $0/1000gal 10 points $0.01<x</=$0.10/1000gal 8 $0.10<x</=$0.50/1000gal 6 $0.50<x</=$1.0/1000gal 3 $1.0<x</=$2.0/1000gal 1 $2.0/1000gal<x 0
Environmental Impacts	Protect wildlife	73	7	Significant Net Env. Benefit 10 points Positive Net Env. Benefit 5 Very Positive Net Env. Benefit 7.5 Little or No Net Env. Benefit 0
Environmental Impacts	Protect critical areas	86	2	
Community Impacts	Clean streets	52	19	Yes = 10 points; No = 0 points
Community Impacts	Maximize associated public improvements	37	20	Yes = 10 points; No = 0 points
Community Impacts	Maximize local park improvements	54	18	Yes = 10 points; No = 0 points
Community Impacts	Eliminate sewer backups	69	11	Reduce frequency of sewer backups: Yes = 10 points; No = 0 points

1 Mean values; 0-100 scoring scale; max. = 100

Table 5 CSO Control Technology Evaluation[1]

Technology	Water Quality: Fecal Coliform (% Removal)[2]	Water Quality: Suspended Solids (% Pollutant Removal)[2]	Water Quality: Floatables (% Pollutant Removal)[2]	Water Quality: Minimize metals (% removed)[3]	Water Quality: Minimize nutrients (% removed)[4]	System Performance: Maximize conveyance	System Performance: Maximize treatment plant capacity	System Performance: Eliminate dry weather overflows	System Performance: Eliminate wet weather overflows (% CSO volume removed)	Public Acceptance: Maximize recreational use[5]	Public Acceptance: Maximize aquatic habitat[6]	Public Acceptance: Minimize public complaints	Public Acceptance: Minimize time for improvements (years)	Cost: Minimize capital costs ($/1000 gal)	Cost: Minimize O&M costs ($/1000 gal)[7]	Environmental Impacts: Protect wildlife[8]	Environmental Impacts: Protect critical areas[9]	Community Impacts: Clean streets	Community Impacts: Maximize associated public improvements	Community Impacts: Maximize local park improvements	Community Impacts: Eliminate sewer backups
Sewer System Optimization																					
Passive CSO Regulators	10%	10%	10%	10%	5%	Y	Y	Y	5%	L	L		2	$ 5.15	$0.15	L	L	N	N	N	N
Active CSO Regulators	15%	15%	15%	15%	8%	Y	Y	Y	10%	L	L		5	$ 5.25	$0.16	L	L	N	N	N	N
Real-Time Control	20%	20%	20%	20%	10%	Y	Y	Y	15%	L	L		7	$17.45	$0.52	L	L	N	N	N	Y
Source Controls																					
Street Sweeping	0%	29%	27%	29%	15%	N	N	Y	0%	L	L		1	$ -	$0.00	L	L	Y	N	N	N
Combined Sewer Flushing	17%	4%	0%	4%	2%	Y	Y	Y	0%	L	L		4	$ -	$0.00	L	L	N	N	N	Y
Catch Basin Cleaning	0%	29%	27%	29%	15%	Y	Y	Y	0%	L	L		3	$ -	$0.00	L	L	Y	N	N	N
Inflow Reduction																					
Upland Stormwater Storage	99%	99%	99%	99%	50%	Y	Y	N	99%	VP	VP		10	$ 0.65	$0.02	S	P	N	Y	Y	Y
Flow Slippage	98%	6%	33%	6%	3%	N	N	N	100%	P	L		10	$ 5.10	$0.15	L	P	N	N	N	Y
Sewer Separation	98%	6%	33%	6%	3%	N	N	N	100%	P	L		30	$20.40	$0.61	L	P	N	Y	N	Y
Physical/Chemical Treatment																					
Nets	0%	0%	95%	0%	0%	N	N	N	99%	P	L		5	$ 2.75	$0.08	P	L	N	N	N	N
Mechanical Bar Screens	0%	0%	80%	0%	0%	N	N	N	99%	P	L		5	$ 2.50	$0.08	P	L	N	N	N	N
Swirl Concentrator	15%	30%	80%	30%	15%	N	N	N	99%	P	L		10	$ 6.30	$0.19	P	L	N	N	N	N
Vortex Separator	20%	40%	85%	40%	20%	N	N	N	99%	P	L		10	$ 5.85	$0.18	P	L	N	N	N	N
Microscreening	33%	50%	95%	50%	25%	N	N	N	99%	P	P		10	$ 7.35	$0.22	S	L	N	N	N	N
Plain Sedimentation	16%	65%	90%	65%	33%	N	N	N	99%	P	VP		15	$ 7.20	$0.22	S	L	N	N	N	N
Flocculation/Sedimentation	28%	80%	90%	80%	40%	N	N	N	99%	P	VP		15	$ 8.45	$0.25	S	L	N	N	N	N
High-Rate Filtration	22%	60%	95%	60%	30%	N	N	N	99%	P	VP		15	$ 4.90	$0.15	S	L	N	N	N	N
Chlorination/Dechlorination	99.9%	0%	0%	0%	0%	N	N	N	99%	P	L		15	$ 2.00	$0.06	L	S	N	N	N	N
Primary Treatment + Disinfection																					
WPAF modifications	99.9%	60%	99%	60%	30%	Y	Y	N	99%	S	P		3	$ 2.00	$0.06	S	S	N	N	N	Y
Storage																					
Closed Concrete Tanks	99%	99%	99%	99%	50%	Y	Y	Y	99%	VP	VP		5	$18.45	$0.55	S	P	N	Y	N	Y
Storage Conduits	99%	99%	99%	99%	50%	Y	Y	Y	99%	VP	VP		10	$19.35	$0.58	S	P	N	Y	N	Y
Storage Tunnels	99%	99%	99%	99%	50%	Y	Y	Y	99%	VP	VP		20	$53.40	$1.60	S	P	N	N	N	Y
Grouped Alternatives																					
Closed Concrete Tanks & Chlorination/Dechlorination	99.9%	99%	99%	99%	50%	Y	Y	Y	99%	S	VP		15	$20.45	$ 0.61	S	S	N	Y	N	Y
Plain Sedimentation & Chlorination/Dechlorination	99.9%	65%	90%	65%	33%	N	N	N	99%	S	VP		15	$ 9.20	$ 0.28	S	S	N	N	N	N
Vortex Separator & Chlorination/Dechlorination	99.9%	40%	85%	40%	20%	N	N	N	99%	S	L		15	$ 7.85	$ 0.24	P	S	N	N	N	N
Nets & Chlorination/Dechlorination	99.9%	0%	95%	0%	0%	N	N	N	99%	S	L		15	$ 4.75	$ 0.14	P	S	N	N	N	N
Nets and Sewer Separation	98%	6%	95%	6%	3%	N	N	N	100%	P	L		30	$23.15	$ 0.69	P	P	N	Y	N	Y
Nets, Sewer Separation, & Chlorination/Dechlorination	99.9%	6%	95%	6%	3%	N	N	N	100%	S	L		30	$25.15	$ 0.75	P	S	N	Y	N	Y

[1]Evaluation assumes flow can be conveyed to the various technologies; implementation will be reviewed in the next phase of the project

[2]Percent removal information mostly from Ron Wycoff's *CSO Control Technology*, CH2M HILL, May 1991 and supplemented by information on various CH2M HILL CSO Control Projects

[3]Metals reduction was assumed to be equal to suspended solids reduction

[4]Nutrients removal was assumed to be equal to 1/2 suspended solids reduction

[5]Maximize recreational use evaluated based on % bacteria and floatables reduction

[6]Maximize aquatic habitat based on % suspended solids, metals, and nutrient removal

[7]O&M costs estimated at a default of 3% of capital costs

[8]Protect wildlife evaluated as % suspended solids and floatables reduction

[9]Protect critical areas evaluated as % bacteria reduction

	L	P	VP	S
Bacteria	<90%	90.0-98.9%	99.0-99.8%	99.9+%
Floatables	0%	>0-50%	>50%	>50%
Suspended Solids / Metals / Nutrients	all 3 @ 0-50%	1>50% & 2 @ 0-50%	2>50% & 1 @ 0-50%	all 3 @ >50%

	L	P	S
Bacteria	<90%	90.0-99.0%	>99.0+%
Suspended Solids / Floatables	both @ 0-50%	1>50% & 1 @ 0-50%	both @ >50%

Figure 4 Results of the CSO Control Technology Evaluation

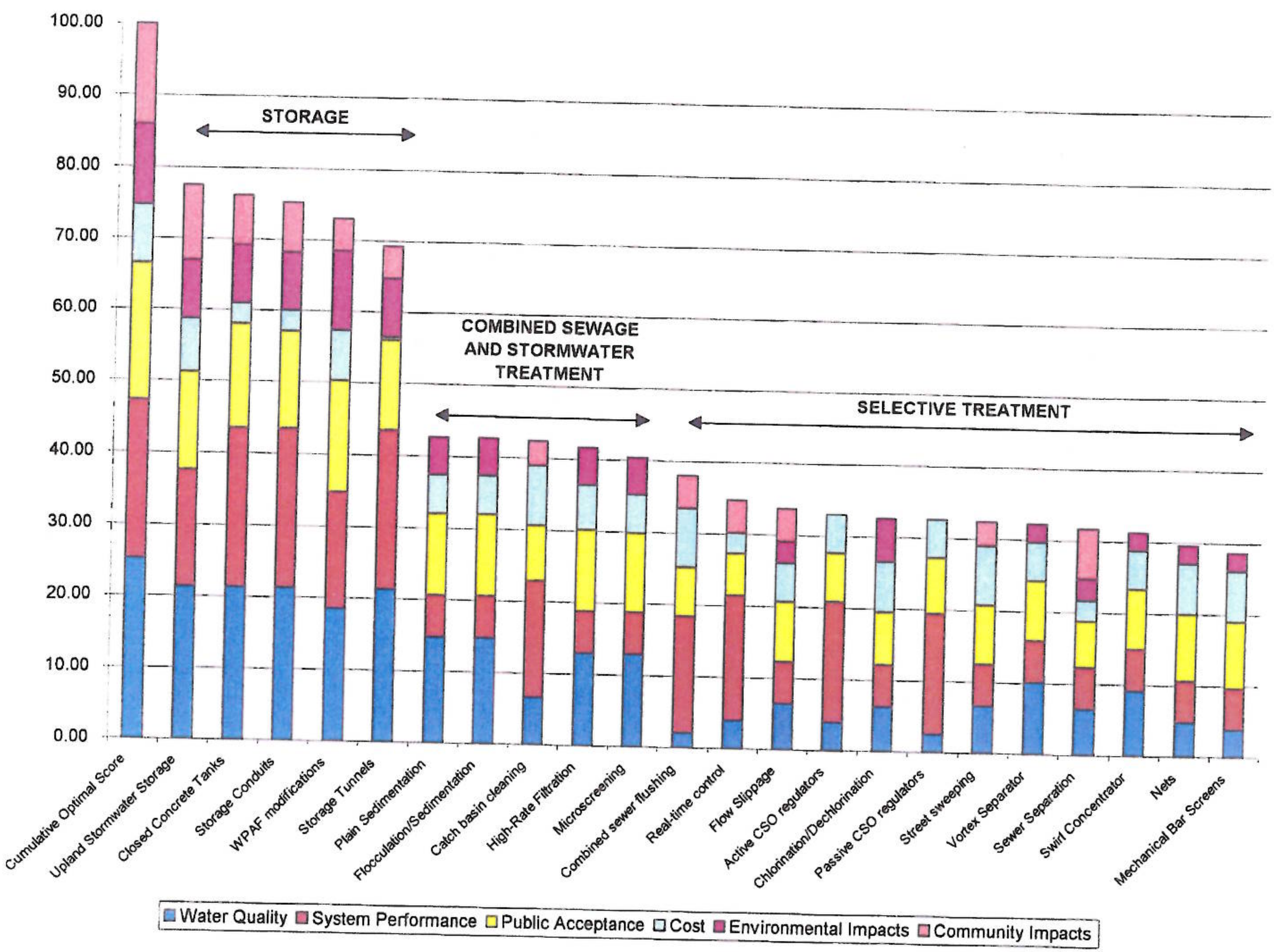


Figure 4.xls Model Results

technical assessment that combined technologies that would be most complimentary to increase CSO control performance and cost-effectiveness. Details of the groupings are included in Table 5. The results of this additional evaluation are presented in Figure 5. The results of this evaluation process identified the following technologies as meeting the mix of evaluation criteria best:

- Closed concrete tanks and chlorination/dechlorination
- Upland stormwater storage
- Below ground CSO storage
- Treatment plant modifications

This analysis concludes Task 6. Next steps are presented in the following section.

Next Steps

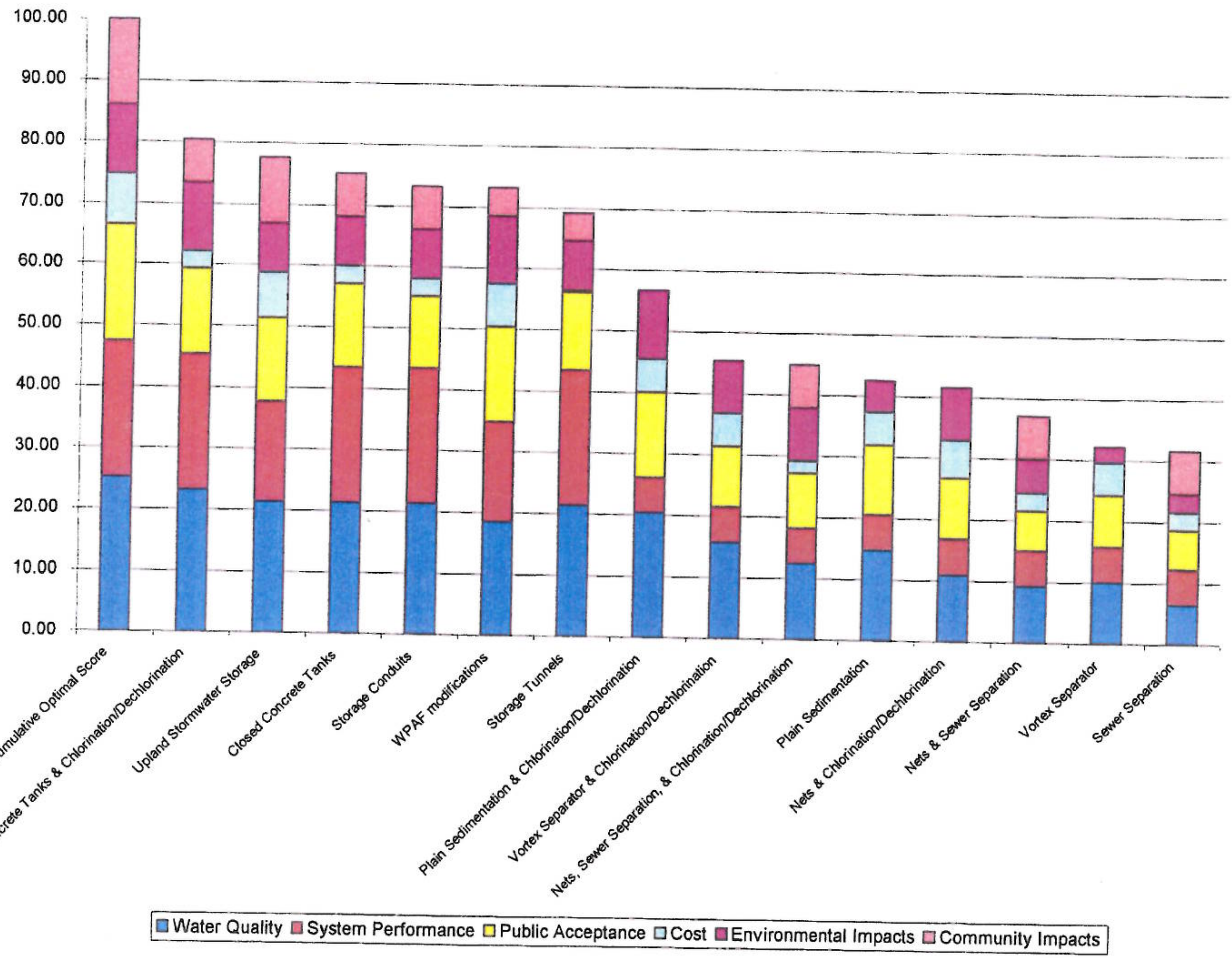
The next steps in the evaluation process, to be performed under Task 7, include a more detailed evaluation of the applicability of the short-listed alternatives as defined above. The short-listed alternatives will be reviewed in addition to the on-going long-term CSO control program of sewer separation. In addition, short-term controls being developed under Task 5, will also aid in reducing the magnitude of the long-term control program.

Not all alternatives are applicable to every CSO location and situation. Detailed facility planning including costs and benefits of applicable alternatives will be developed. If none of the short-listed alternatives apply or are not cost-effective relative to the benefits derived, then additional technologies previously considered will be evaluated for select sites.

Facility planning will be based on sewer system computer modeling results that predict CSO activity, including volume, frequency, and duration. The computer modeling results will also provide input to determine pollutant loads at individual CSOs and conclude Task 4, Hydraulic Characterization. The results of the on-going Tasks (Tasks 4 and 5), together with the results of Task 7, will form the basis of Task 8, Long-Term CSO Control Plan.

At this time, a stakeholder meeting is anticipated for the spring of 1999 to review implementation of alternatives for CSOs tributary to each of the various receiving waters. A second public meeting is anticipated for the summer of 1999 to review progress to date and solicit feedback.

Figure 5 Results of the Preliminary Screening of CSO Control Alternatives



References

Cardinal Engineering Associates, Inc. 1981. *Facility Plan, Sewage Collection System.* Volume 1.

Cardinal Engineering Associates, Inc. 1988. *Update and Supplement to Facility Plan for Elimination of Combined Sewer Overflows.*

CH2M HILL. 1991. *CSO Control Technologies Assessment.* Technology Transfer Seminar, Gainesville, Florida. May 21-23, 1991

CH2M HILL. April 1997. City of New Haven Long Term CSO Control Plan, Contract Attachment C, *Scope of Services.*

CH2M HILL. June 1997. City of New Haven Long Term CSO Control Plan, Technical Memorandum #1, *Project Goals and Approach.*

CH2M HILL. July 1997. City of New Haven Long Term CSO Control Plan, Technical Memorandum #2, *Database Design and System Modeling Approach.*

CH2M HILL. March 1998. City of New Haven Long Term CSO Control Plan, Technical Memorandum #5, *Monitoring Program Results.*

CH2M HILL. June 1998. City of New Haven Long Term CSO Control Plan, Technical Memorandum #7, *Nine Minimum Controls Report.*

CH2M HILL. August 1998. City of New Haven Long-Term Combined Sewer Overflow Control Plan. *Project Information for Stakeholders.*

CTDEP. 1994. State of Connecticut Department of Environmental Protection, NPDES Permit Modification, September 1994.

United States Environmental Protection Agency (EPA). 1994. *Combined Sewer Overflow (CSO) Control Policy.* Federal Register, Vol. 59, No. 75. FR Doc. 94-9295.

Appendix A CSO Control Technologies Fact Sheets

Sewer System Optimization: Improve/Retrofit Static-Flow Control

Description: Static flow control includes those sewer system BMPs which maximize flow to the treatment plant while minimizing overflow, bypass, and flooding, using simple control devices to develop potential in-line storage. These flow control devices will usually, but not always, be associated with the combined sewer regulators and may include fixed weirs, orifices or static vortex controllers.

Advantages:

Where plan maximizes use of existing facilities and uses conventional technology:

- Relatively easy and quick to implement
- Minimal maintenance and management requirements
- Inexpensive control devices

Disadvantages:

Where plan requires new construction for consolidation of regulators/outfalls:

- Maximum pollutant reduction = +/- 10 percent
- Installation may be difficult, especially in congested areas
- Hydraulic constraints may limit use, especially where sewer slopes limit consolidation options

Applicability:

Flat sewers with excess capacity and limited flooding potential offer the best sites.

Sewer System Optimization: Improve/Retrofit Variable-Flow Control

Description: Variable in-sewer flow control devices include sluice gates and inflatable dams which may be closed to induce in-line storage and opened to dewater the stored flow. The purpose is the same as the static flow control devices; however, operation flexibility is increased and the risk of unwanted flooding is decreased. In general, the scale of the projects is larger than for the static control alternatives.

Advantages:

Where plan maximizes use of existing facilities and uses conventional technology:

- Short implementation period
- Inexpensive control devices

Disadvantages:

Where plan requires new construction for consolidation of regulators/outfalls:

- Maximum pollutant reduction = +/- 15 percent
- Installation may be difficult, especially in congested areas
- Maintenance is expensive and is often under difficult conditions
- Hydraulic constraints may limit use
- Operations criteria need to be formulated

Applicability:

Typically applicable to large trunk sewers only due to the scale of the control devices.

Sewer System Optimization: Real-Time Control

Description: Real time control includes design and installation of a network of rain gages, flow gages, level sensors, overflow detectors, and remote system controls such that all variable system components, including gates, inflatable dams, etc., can be operated from a central location during a storm event (i.e., in real time) to minimize overflow.

Advantages:

- Provides the most flexibility in controlling a large system
- May provide in-line storage in areas where static storage is infeasible
- Logical extension of existing system management (high-tech appeal)
- Easier to control variable-flow controls from a central location
- Responsive to variable demands placed on the system by uncertain rainfall events
- Moderate implementation period
- Some O&M and staffing savings from centralized facilities.

Disadvantages:

- Maximum pollutant reduction = +/- 20 percent
- Requires highly trained personnel to manage control systems
- Maintenance needs for monitoring equipment and controls higher
- Operational control strategies may be complex
- Hydraulic constraints may limit use

Where plan requires new construction for consolidation of regulators/outfalls will have the same limitations as static and variable-flow control

Applicability:

- Large collection and the interceptor systems where there is significant in-line storage potential that cannot be developed by static or variable flow controls alone

- In general, real time control is more effective, and therefore more applicable, in the Pacific Northwest than it is in the Midwest or eastern United States. The long duration low intensity rainfall events, typically encountered in the northwest, can be controlled by this technology more effectively than can the short duration high intensity storms, typical in other parts of the country.

Source Control: Street Sweeping

Description: Although the major objective of municipal street sweeping is to enhance roadway appearance, the periodic removal of surface accumulations of litter, debris, dust, and dirt also reduces transport of such material into the sewer system. Common methods of street sweeping include manual sweeping, mechanical broom sweepers, and vacuum sweepers. Its effectiveness is a function of several factors: sweeper efficiency, cleaning frequency, number of passes, equipment speed, pavement conditions, equipment type, part of streets swept, litter control programs, and parking restrictions.

Advantages:

- Easily applied to highly developed urban areas
- Requires no new construction
- Has aesthetic appeal and provides visible action
- Street sweeping programs currently are established
- Effective for removing heavy metal, particularly lead, accumulation in streets
- Is reasonably cost-effective for removing floatables, TSS and heavy metals resulting from atmospheric deposition

Disadvantages:

- Effectiveness is highly related to the type and quality of pavement
- Will not reduce fecal coliform
- Not easily applied to highly developed urban areas with limited parking
- Institutional constraints
- Relative removal of biochemical oxygen demand (BOD) and suspended solids is small compared to the total CSO load

Applicability:

- Highly developed and established urban areas
- Curbed streets only

Source Control: Combined Sewer Flushing

Description: By introducing a controlled volume of water over a short duration at key points in a combined sewer system, deposited sewage solids can be resuspended and transmitted to the dry-weather treatment facility before a storm event produced flows that carries the solids to a receiving water. Water for flushing can be supplied either externally (from a tanker truck, for example) or internally (by manual or automatic detention).

Research has shown that no significant gain in the fraction of load removed is achieved by repeated flushing at a single point and that 70 percent of the flushed solids will resettle downstream quickly. Significant pollutant reductions can probably best be effected by sequential flushing at key points in a downstream direction, to keep the suspended solids in motion.

Advantages:

- A sewer flushing program can be implemented with little or no new construction
- Reduces CSO treatment needs during wet weather
- Increases the sewer's hydraulic capacity and in-line storage, especially with optimization controls
- Delivers pollution to interceptors for treatment at the WPAF
- Can be automated, in combination with in-line storage
- Good (20 to 30 percent) removal of BOD and heavy metals with even higher efficiencies for organic compounds and nutrients

Disadvantages:

- Requires intensive management
- Automated flushing systems may become complex and installation may be difficult
- Will reduce only "first flush" effects
- Maximum possible removal of fecal coliform is approximately 20 percent
- Will not reduce frequency or duration of CSO, and may increase magnitude by increasing sewer capacity, unless coupled with sewer optimization controls

Applicability:

- Combined sewer flushing is most applicable to flat sewers where pollutants accumulate and enough water can be surged to produce a significant "first flush" effect
- Generally not applicable to steep sewers

Source Control: Catch Basin Cleaning

Description: Catch basins are installed in combined sewer systems to capture grit and other solids before entering the drainage system. Catch basins are designed to trap sediment whereas stormwater inlets are not. Frequent removal of accumulated catch basin deposits is a method often proposed in CSO control programs to reduce the heavy "first flush" effect of deposited solids from stormwater flows and to help reduce sediment buildup in the sewers. Cleaning can be done manually or by an eductor, a bucket, or a vacuum.

Advantages:

- Maintains system efficiency
- Significant (20 to 30 percent) reductions in TSS and floatables are possible
- Reduces sediment, and associated pollutants, accumulation in the CSO generated by small runoff events

Disadvantages:

- Vacuums and eductors are noisy, but generally cleaner than buckets
- Cleaning schedules may need to be adjusted for areas with traffic congestion
- Overall pollutant removals generally are low
- Will only reduce "first flush" effects
- Will not reduce fecal coliform
- Will not reduce frequency or duration of CSO, and may increase magnitude by increasing sewer capacity, unless coupled with sewer optimization controls
- Required cleaning frequency (and therefore cost) is difficult to predict without conducting long-term, site-specific studies on accumulation of catch basin debris

Applicability:

To all catch basins

Inflow Reduction Technique: Upstream Stormwater Storage

Description: Stormwater retention and detention ponds are common techniques used to control peak rates and volumes of surface runoff in areas served by separate storm sewers. Such ponds can be used in a combined sewer service area to control the rate of surface runoff entering the combined sewer collection system. Reduced flow rates in the combined sewers will result in direct interception and treatment of a larger part of the flow, thus reducing the volume of CSO.

Advantages:

- Can achieve high levels of control (more than 90 percent)
- Is a cost-effective technique for reducing inflow
- Retention removes relatively clean stormwater from the CSO, which needs to be handled downstream
- Detention reduces the peak flow rates, peak overflow rates, and overflow volume
- Existing upland natural and storm drainage systems could be used to their maximum capacity

Disadvantages:

- Siting of required stormwater basins in developed upstream areas or steep terrain may be difficult
- Some upstream detention may contribute to localized flooding (e.g., wet basements) unless coupled with pumping
- Many basins are required for areawide applications
- Natural wetland ecosystems may not tolerate additional ponding
- Upstream storage may not be compatible with existing land use

Applicability:

In upstream parts of the combined sewer service area where topography and land use permit the siting of surface stormwater ponds

Inflow Reduction Technique: Flow Slippage

Description: Flow slipping is a method of preventing stormwater from entering the sewer system at a location thereby channeling the flow to an alternate destination. This is typically performed by altering the inlets to surface drains to block inflow and allow it to "slip" by.

Advantages:

- Relatively easy to alter the existing system
- Can be very cost-effective in appropriate areas
- Maximizes use of existing sewer system
- Has the CSO reduction effectiveness of sewer separation
- Requires minimal construction

Disadvantages:

- Requires sloping terrain
- Surface flow can create local nuisance conditions
- Increase in current surface runoff pollutant loads may not achieve water quality goals
- Increase in current surface runoff quantities may invoke stormwater regulations

Applicability:

Most applicable in areas with adequate grade to enhance runoff or suitable to flow diversion.

Inflow Reduction Technique: Sewer Separation

Description: Sewer separation requires construction of either new sanitary sewers or new storm sewers within the combined sewer service area. The existing combined sewers will then function as either sanitary or storm sewers, depending on the design of the newly constructed sewers. Complete sewer separation is the only method by which wet-weather CSO can be eliminated because stormwater and municipal wastewater are carried in two separate systems. However, removing the sanitary component from the wet-weather flow will not eliminate wet-weather pollution because most of the pollution load is carried by urban stormwater runoff.

Sewer separation may be complete or partial. Complete separation attempts to exclude all surface runoff from the sanitary waste stream, whereas partial separation attempts to remove most of the surface runoff from the combined system.

Partial separation is often used in communities where sanitary flow and roof drainage are served by common house connections, making complete separation almost impossible. It is most often accomplished by constructing a new storm sewer system to collect street and area drainage. Roof drainage and sanitary flow would be carried by the old system.

Advantages:

- Eliminates or reduces CSO by eliminating or reducing the combined sewer service area
- Permanent solution
- Some urban amenity improvement potential is possible
- Negligible additional O&M requirements

Disadvantages:

- High capital costs
- Very disruptive during construction
- Difficult in utility congested streets and high population density areas
- Requires significant right-of-way and new facilities
- Long implementation time to complete projects
- Converts tributary area from combined sewers to separate urban storm sewers and, therefore, only partially removes receiving water pollutant loads
- Increase in current surface runoff may invoke stormwater regulations
- Velocities in remaining sewers may not be self-cleaning

Applicability:

- Best in areas of new construction
- Area wide where right-of-way is available

Inflow Reduction Techniques: Infiltration/Inflow Reduction

Description: Infiltration/Inflow (I/I) can account for a significant quantity of the flow being transported in a sewer system. I/I can increase treatment costs at the treatment facility by adding significant quantities of water of variable quality and reducing the efficiency of some treatment equipment.

Sewered areas, which experience significant infiltration from groundwater or tidewater into sewers, are often indicative of sewers in need of repair, lining, or replacement. Inflow represents the introduction of stormwater flow via connections to the combined sewer such as roof drains and basement sump pumps. Inflow can be disconnected form the combined sewer and redirected to separate storm systems or surface ponding, for example.

Advantages:

- Makes existing in-system storage capacity available
- Increases efficiency of existing sewerage conveyance system
- No land requirement

Disadvantages:

May not reduce or eliminate all CSO flows

Applicability:

System-wide

Treatment: Nets

Description: Nets are static-flow control devices for either end-of-pipe collection or area collection in a receiving water body. Netting systems typically are modular and use the energy of the effluent stream to push the floatable materials into the plastic or mesh netting. Most nets are made buoyant by floats or pontoons.

Currently, several municipalities use nets at or downstream of the combined sewer regulators to reduce solids and floatables from existing regulators.

Advantages:

- Maximizes use of existing facilities
- Uses conventional technology
- Has minimal hydraulic problems
- When installed in lakes, tributaries or quiescent estuarine waters, nets are inexpensive
- Moderate implementation period

Disadvantages:

- Installation may be within view
- Maintenance access can be difficult
- Replacement costs are high for torn nets or booms; potential high maintenance costs
- Nets are installed at end of pipe or in the receiving stream
- Only captures floatables and aesthetic nuisances
- No significant water quality improvement
- Needs to be cleaned after each overflow event
- Potential for odors and an aesthetic nuisance if near high-use water front areas
- Not viable in rough, open water or water with large tidal variations
- Limited knowledge of successful use in riverine and high-energy estuarine environments

Applicability:

Flat sewers with flooding potential typically are the best for this end-of-pipe technology.

Treatment: Microscreens

Description: Microscreens have very small openings, generally less than 1/250 inch (i.e., 0.1 mm) and are intended to provide significant removals of suspended solids and associated BOD_5, toxins, etc. Removal performance tends to improve as influent suspended solids concentrations increase due to the relatively constant effluent concentrations. In addition, screens develop a mat of trapped particles, which acts as a strainer, retaining particles smaller than the screen aperture. Chemical additives can be used to improve process removal efficiencies.

Advantages:

- Provide main treatment to CSO flow
- Good solids removal
- Relatively small land requirements
- Mature technology
- Series of screens can be clustered in order to handle varying ranges of flow
- Lends to automatic operation

Disadvantages:

- Additional design and operation requirements when a network of screens are utilized
- No treatment of dissolved pollutants
- Requires sludge handling
- May require influent pumping
- Efficiencies vary since the effluent nearly always has a constant concentration
- Requires conventional building and power facilities

Applicability:

The main treatment device of a storage/treatment system

Treatment: Mechanical Screens

Description: Coarse screening provides pretreatment and protects downstream equipment from damage by coarse material found in combined sewer flow. Mechanically cleaned bar screens remove screenings on a duty cycle or differential head method. Mechanically cleaned screens have openings that range from 3/8 inch to 1.5 inches.

Advantages:

- Protect downstream facilities
- Moderately inexpensive

Disadvantages:

- No significant improvement to water quality
- Need to be maintained and require a power source

Applicability:

Generally a required pretreatment feature associated with any of the other treatment processes

Treatment: Coarse Screens (manually cleaned)

Description: Coarse screening provides pretreatment and protects downstream equipment from damage by coarse material found in combined sewer flow. Coarse screens have openings that range from 3/16 to 1 inch.

Advantages:

- Protect downstream facilities
- Uses conventional technology
- Inexpensive

Disadvantages:

- No significant improvement in water quality
- Only captures floatables, aesthetic nuisances, unless using microscreens
- Requires new construction
- Installation may be difficult, especially in congested areas
- Potential for odor from screened solids
- Need to be cleaned after each overflow event

Applicability:

Generally a required pretreatment feature associated with any of the other treatment processes

Treatment Systems: Swirl Concentrator and Vortex Separator

Description: Swirl concentrators regulate both the quantity and quality of CSO at the point of overflow. Solids separation is caused by the inertia differential that results from a circular path of travel. The flow is separated into a large volume of clear overflow and a concentrated low volume of waste that is intercepted for treatment at the dry-weather wastewater treatment plant.

Pollutant removal performance of swirl concentrators, at a given hydraulic loading rate, depend on the relative settleability of the waste stream being processed. Solids separation performance is much better for large gritty material than for smaller and lighter particles.

Advantages:

- High-rate primary treatment for solids removal
- No moving parts
- Accept a wide range of flow rates
- Relatively small land requirements
- Good cost-effectiveness for TSS removal

Disadvantages:

- Estimated TSS removal is 30 to 40 percent
- Influent pumping will likely be required for many potential sites
- Limited capacity to remove floatables
- Relatively new technology with limited demonstrated feasibility for full-scale applications
- Design criteria are not well established
- Solids handling may be required
- Requires new construction
- Installation may be difficult, especially in congested areas

Applicability:

Main treatment device of a storage and treatment system

Treatment: Gravity Sedimentation (primary treatment)

Description: The objective of sedimentation is to produce a clarified effluent by gravitational settling of the suspended particles that are heavier than water. Sedimentation is one of the most common and well-established unit operations for wastewater treatment. Sedimentation also provides storage capacity, and disinfection can be affected concurrently in the same tank. It is also very adaptable to chemical additives, such as lime, alum, ferric chloride, and polymers, which remove suspended solids, BOD, nutrients, and heavy metals at higher rates.

Advantages:

- Minimal power and maintenance requirements
- Well-understood technology
- Sedimentation basins will provide some storage
- Fairly high TSS removal (65 percent)
- Simple in design and operation

Disadvantages:

- Large land area requirements
- Medium cost-effectiveness
- Installation may not be practical in congested areas
- Could be aesthetically unappealing
- Easy to forget to maintain basins

Applicability:

Only in the less populated parts of the planning area where land is available, at the end of existing CSO outfalls or along the riverfront

Treatment: Flocculation/Sedimentation

Description: Flocculation, a unit process preceding sedimentation or filtration, is used to increase the removal efficiency of the sedimentation process. The major objective of flocculation (including coagulation) is to permit aggregation of colloidal particles prior to sedimentation. Coagulation is the term, which describes the overall process of particle aggregation, including both particle transport to cause inter-particle contact and particle destabilization to permit the attachment of particles once contact has occurred. Flocculation is the term used to describe the transport step only. Coagulation requires the addition and mixing of chemical additives.

Sedimentation's objective is to produce a clarified effluent by gravitational settling of the suspended particles that are heavier than water. It is one of the most common and well established unit operations for wastewater treatment. Sedimentation also provides storage capacity, and disinfection can be affected concurrently in the same tank. It is also very adaptable to chemical additives such as lime, alum, ferric chloride, and polymers, which provide higher suspended solids, BOD, nutrients and heavy metals removal.

Advantages:

- Proven technology
- Improved performance (80 percent TSS removal) compared to gravity sedimentation
- Sedimentation basins will provide some storage

Disadvantages:

- Large land area requirements
- Medium cost-effectiveness
- Additional O&M requirements
- Additional sludge handling
- Installation may not be practical in congested areas

Applicability:

Only in the less populated portions of the planning area where land is available

Treatment: High Rate Filtration

Description: High rate filtration typically refers to a filter which has two media: anthracite coal and fine sand. Periodic backwashing of the filter bed must be provided (even if prefiltration is used) because suspended solids will clog the filter. High rate filtration has been applied to CSO treatment previously. However, it is more common in the treatment of industrial wastes. Flocculation is often used in conjunction with high rate filtration.

Advantages:

- Moderate land requirements
- Fairly high TSS removal (+/- 60 percent)

Disadvantages:

- High O&M requirements
- Pretreatment is required to remove coarse solids
- Aesthetically unappealing
- Limited CSO control experience
- Medium cost-effectiveness

Applicability:

Generally applicable to CSO treatment if facility can be sited at or near outfall(s)

Treatment: Chlorination

Description: The major objective of chlorination, or disinfection by other means, is to control pathogens and other microorganisms in receiving waters. The disinfection agents commonly used in CSO treatment are chlorine, calcium or sodium hypochlorite, and chlorine dioxide. Physical methods and other chemical agents have not had wide usage because of excessive costs or operational problems. The choice of a disinfecting agent will depend on the unique characteristics of each agent, such as stability, chemical reactions with phenols and ammonia, disinfecting residual, and health hazards. Adequate mixing must be provided to force disinfectant contact with the maximum number of microorganisms. Mixing can be done by mechanical flash mixers at the point of disinfectant addition, at intermittent points by specially designed contact chambers, or both.

Advantages:

- Only physical-chemical treatment alternative that provides disinfection
- Publicly acceptable practice
- Mature technology
- Many suppliers of equipment and supplies

Disadvantages:

- Corrosive and toxic chemicals must be transported, stored, and handled
- Requires a moderate level of equipment and storage facilities
- Chlorine residuals in treated effluent are toxic to aquatic life

Applicability:

To all CSO storage and treatment systems where disinfection is required

Treatment: Dechlorination

Description: Since about 1970, much attention has been focused on the toxic effects of chlorinated effluents. Both free chlorine and chloramine residuals are toxic to fish and other aquatic organisms. Dechlorination typically involves the addition of sulfur dioxide to the wastewater. This process will produce small amounts of sulfuric and hydrochloric acids. However, they are generally neutralized by the buffering capacity of the wastewater. Sulfur dioxide is fed as a gas, using the same equipment as chlorine systems. Because the reaction with free or combined chlorine is practically instantaneous, the design of contact systems are less critical than that of chlorine contact systems.

Advantages:

- Removes chlorine residuals that are harmful to natural waters
- Mature technology
- Easily incorporated with chlorination facilities
- Very effective with little additional mixing and detention

Disadvantages:

- Sulfur dioxide is toxic in concentrated form
- Little experience using other dechlorination agents (e.g., metabisulfite, bisulfite, or sulfite salts)

Applicability:

In conjunction with chlorination facilities

Treatment: Treatment at East Shore WPAF

Description: This technology includes reviewing the various treatment facility components to determine if and how additional wet weather flows can be treated at the existing treatment facility. This technology is included in EPA's NMCs and can often be cost-effectively implemented and provide significant water quality benefits.

New Haven's East Shore WPAF has two incoming conveyance pipelines: one conveys pumped flow from the East Street Pump Station and the other conveys flow by gravity. Together the incoming flow is pumped at the WPAF by five raw sewage influent pumps, each with a maximum capacity of 25 mgd, and three primary clarifiers, each with a maximum capacity of 50 mgd. Presently, only two out of the three clarifiers can operate at a time while their use is being rotated to upgrade the units. It is anticipated that by summer 1999, all three clarifiers will normally be available for use during extreme wet weather conditions. Primary treatment capacity is presently limited to 100 mgd. Secondary treatment units are limited to 60 mgd, and conveyance between primary and secondary is limited to approximately 100 mgd. All flows totaling 60 mgd and below receive full preliminary, primary, and secondary treatment and chlorination. Flows above 60 mgd to 100 mgd receive preliminary and primary treatment and are then blended with secondary effluent and chlorinated.

A modification to the WPAF to increase capacity during wet weather would include utilization of the third primary clarifier as a wet weather treatment facility. It is proposed to introduce hypochlorite at the primary clarifier influent via installation of approximately 100 feet of 1-inch pipe from the new hypochlorite storage facility to the primary clarifiers due to the conveyance limitations between primary and secondary treatment and install approximately 1,800 feet of 60-inch conveyance pipeline to channel flows from the primary clarifier receiving chlorine to the WPAF outfall to mix with the remaining chlorinated flows from secondary treatment. Isolation of flows at the effluent box will be required and two 60-inch sluice gates are also proposed, one at each end of the 60-inch pipeline for flow control. This modification would provide another 50 mgd of primary treatment capacity that could be used for wet weather flows exceeding the 60-mgd secondary treatment capacity of the WPAF, boosting the plant total wet weather peak flow capacity to 150 mgd, including 90-mgd of flow receiving preliminary and primary treatment and chlorination.

Advantages:

- Maximizes use of current treatment capacity
- Provides uniform and high-level treatment of all captured CSO
- Provides centralized processing for all wastewater

Disadvantages:

Maximizes storage requirements if plant is not expanded because CSO treatment capacity will be available after the storm

Applicability:

Any treatment facility with spare capacity

Storage: Open Concrete Tanks

Description: Open concrete tanks have the same function as earthen basins. However, concrete tanks generally are more durable than earthen basins and have more storage volume per unit of land area. Aeration and washdown facilities are required to prevent anaerobic conditions and to provide for cleaning after each event. Some smaller tanks can be designed to be self-cleaning, using a sloping floor and an automatic sediment flushing device.

Advantages:

- Efficient use of available land in relation to earthen basins
- Storage tanks may be distributed throughout the combined sewer service area where they are most needed

Disadvantages:

Site must be fully dedicated to pollution control

Applicability:

Siting generally is restricted to areas of relatively low population density and industrial use

Storage: Closed Concrete Tanks

Description: Closed concrete tanks generally are constructed below grade and provide a completely enclosed unit for storing captured CSO. Such tanks must be equipped with maintenance access, aeration facilities, and washdown or sediment flushing equipment.

Advantages:

- Can be located in relatively high-intensity land-use areas
- May allow up to 100 percent reduction in CSO volume, frequency and magnitude
- Provides effective CSO storage for subsequent treatment
- Some urban amenity improvement potential is possible
- Multiple land use is possible. For example, the area above closed concrete storage tanks can be used for open parkland or for parking lots
- Closed concrete tanks can be distributed throughout the combined sewer service area

Disadvantages:

- Closed concrete tanks are expensive in relation to open tanks and earthen basins
- Requires large pumping facilities to treatment systems

Applicability:

Areawide, except perhaps for the most highly developed downtown areas

Storage: Storage Conduits

Description: Storage conduits are similar to traditional dry-weather wastewater interceptors except that storage conduits are much larger. The function of the conduits is to (1) provide the required CSO storage, (2) consolidate several (or all) combined sewer outfalls, and (3) provide conveyance capacity. In general, such systems would be constructed downstream from the existing combined sewer regulators, along the waterfront, and below ground level. One or more pumping stations would be required to dewater the storage conduit(s) after a wet-weather event.

Advantages:

- Provides a consolidated storage system, whereby the total storage volume is available to many outfalls. This is a more efficient storage configuration than providing individual storage tanks at individual outfalls.
- Minimizes the need for wet-weather outfall consolidation conduits.
- May allow up to 100 percent reduction in CSO volume, frequency and magnitude
- Provides effective CSO storage for subsequent treatment
- Some urban amenity improvement potential is possible
- May be phased easily
- Restricts construction activities to a narrow corridor parallel to existing wastewater interceptors.

Disadvantages:

- Subsurface construction must be done along the waterfront and is often extensive, difficult, and expensive.
- Require pumping facilities to treatment systems
- May require substantial land area for conduit right-of-ways
- Costs about the same as closed concrete tanks

Applicability:

Areawide along the waterfront

Storage: Storage Tunnels

Description: The deep-tunnel alternative provides consolidated off-line storage in tunnels excavated in bedrock below the sewer system and other existing utilities. A complete deep-tunnel system includes four main components:

1. Near surface conduits to consolidate the flow from several outfalls
2. Drop shafts to convey the consolidated flow to the tunnels
3. Deep tunnels to store the flow and interconnect the drop shafts
4. One or more pumping stations to transfer the stored CSO to treatment

Advantages:

- Minimal land requirements
- May allow up to 100 percent reduction in CSO volume, frequency and magnitude
- Large storage capacities can be developed for high levels of CSO capture
- Centralized storage system is available to capture combined sewer flow wherever it occurs in the service area
- Aesthetically appealing minimization of surface facilities
- Marginal cost of tunnel storage is low
- Uses existing wastewater treatment facilities including outfalls
- Captured CSO is removed from local receiving waters
- Eliminates dry-weather CSO resulting from regulator malfunctions

Disadvantages:

- Major construction required
- Near surface consolidation system may be difficult to construct
- Very large initial capital cost for near surface consolidation, drop shafts, and pump-out facilities

Applicability:

Areawide

Appendix B Minutes of Stakeholder Meetings

New Haven Long-Term Combined Sewer Overflow Control Plan - Stakeholder Meeting #1 Minutes

ATTENDEES:

Mark Tedesco/US EPA Long Island Sound
Larry Smith/City of New Haven Engineering Department
Joy Ford/City of New Haven Planning Department
Curt Johnson/CT Fund for Environment
Sigrund Gadwa/Quinnipiac River Watershed Association
David D. Reher/Friends of West River Memorial Park
Roy Schiff/Yale University Center for Coastal and Watershed Systems
Edward Grant/City of New Haven Environmental Council
Bill Hogan/CT DEP, Water Management
Penny Howell/CT DEP, Fisheries
Paul Kowalski/New Haven Health Department
Emly McDiarmid/Yale University FES, Center for Coastal and Watershed Systems
Lewis Madley/New Haven Health Department Bureau of Labs
Peter Davis/New Haven Riverkeeper
Jackie Pernell/CT DEP, Environmental Equity Program
Richard Fasano/New Haven Parks Department
Navis Bermudez/Yale University FES
Heather Langford/Yale University FES
John Hudak/S. Central CT Regional Water Authority
Richard Cleary/City of New Haven Department of Engineering
Dick Miller/City of New Haven, City Engineer
Bangalore P. Neelakantiah/United International Corporation
Ray Smedberg/New Haven Water Pollution Control Authority
Edith Pestana/CT DEP, Environmental Equity Program
Peter von Zweck/CH2M HILL
Dave Burna/CH2M HILL
Rita Fordiani/CH2M HILL
Bryan Cote/Percival Communications

FROM: Rita Fordiani/CH2M HILL

DATE: September 22, 1998

The first stakeholder meeting for the City of New Haven Combined Sewer Overflow (CSO) Control Project was held on Thursday, September 17th from 6:00 to 8:30 PM in the Public Hearing Room at 200 Orange Street in New Haven, CT. The purpose of the meeting was to provide an overview of the status of the New Haven Long-Term CSO Control Plan, present information on typical CSO issues and how other communities are addressing CSOs, and to solicit input from the stakeholders on what their primary concerns are related to this program. Rather than repeat the material in the presentation, these minutes will present meeting highlights, stakeholder input, and record outstanding (parking lot) issues. For those stakeholder representatives who were unable to attend the meeting we will also include a copy of the meeting presentation handouts.

Meeting Highlights

- During the introductions, meeting attendees were asked to briefly state their interest in being a stakeholder for the project. Their responses are included herein as part of the attendance sign-in sheet.

- Several meeting participants shared their local knowledge of critical areas of water quality concern; we hope to collect as much of this detail as possible before the next stakeholder meeting on Tuesday, October 13th.

- There is great interest in pollutant source and receiving water quality characterization; we expect to provide New Haven CSO flow, volume, duration, pollutant load, and drainage area information and available receiving water quality data at the October 13th stakeholder meeting.

- Other CSO communities have altered existing CSO plans to comply with changing regulations, to reduce cost, to achieve higher levels of pollutant control; in all cases, a combination of CSO control technologies matched the communities' goals for providing the required water quality benefits at acceptable costs. Stakeholder involvement early in the process has been a critical lesson learned in other CSO programs.

- Stakeholders were asked to share their primary concerns related to the project; their input is attached. Many stakeholders reiterated the need to improve water quality in the receiving waters. Stakeholder concerns will be discussed in greater detail at the October 13th meeting.

- Stakeholders were randomly separated into six groups and asked to comment on the following six issues:

  - System performance goals
  - Regulatory goals
  - Receiving water goals
  - Cost goals
  - Public involvement goals
  - Other goals

  Each stakeholder was then asked to vote on his or her top three issues; their input is attached. These issues and votes will be discussed in greater detail at the October 13th meeting.

- Stakeholders were queried regarding their preference/ability to participate in upcoming stakeholder meetings held on certain dates or at certain times; the unanimous response was a daytime preference for a meeting time and no preference for particular meeting days. It was agreed that the October meeting time would be changed to 4:00 to 6:30 PM.

Next Steps

Based on the goals and objectives listed by the stakeholders, technical experts will develop an alternatives evaluation model to address technology selection issues. An initial ("first-cut") model will be presented to the stakeholders during the October 13th meeting. At that time, participants will be able to comment on and modify this initial model. Once the stakeholders are satisfied that the model encompasses the spectrum of community concerns, they will prioritize the importance of performance metrics that form the basis of the model (this corresponds to supplying the policy concerns and direction for the evaluation process). A completed model that provides an explicit basis and method for assessing the performance of each technology and alternatives will be developed from the outcome of this meeting.

Parking Lot

The "parking lot" is the meeting board to "park" unanswered meeting questions. The following presents the questions received at the meeting that could not be answered at the time of the meeting. The intent is that the project team will provide information and a response to these issues at the October 13th stakeholder meeting.

1. What is the frequency of storm events that increases wastewater treatment plant flows a) above the plant's secondary capacity and b) above the plant's primary capacity?
2. What are the volume, frequency, and duration of New Haven's CSOs?
3. Include private beaches and other swimming areas on project area map (Figure 1).
4. Present available water quality information for project area.

Upcoming Meetings

- A second stakeholder meeting is scheduled for Tuesday, October 13th from 4:00 to 6:30 PM in the Public Hearing Room at 200 Orange Street, New Haven, CT. Participants will review prioritization of project goals and development of evaluation criteria to determine appropriate CSO control technologies. Sandwiches and refreshments will be served. Please *R.S.V.P.* to Bryan Cote at Percival Communications: phone (860) 677-5076; fax (860) 677-5078; email perccomm@aol.com.
- The first public meeting will be held in mid-November. Date and time to be determined.
- An alternatives evaluation workshop will be held in early 1999.

Communication

Please do not hesitate to contact the following project staff:

Regarding logistical information:

Bryan Cote
Percival Communications
P.O. Box 1302
Avon, CT 06001
Phone: (860) 677-5076
Fax: (860) 677-5078
Email: brycote@aol.com

Regarding technical information:

Rita Fordiani
CH2M HILL
50 Staniford Street
Boston, MA 02114
Phone (617) 523-2260 x210
Fax: (617) 723-9036
Email: rfordian@ch2m.com

City of New Haven Long-Term Control Plan - Stakeholder Input

Stakeholder Concerns

Each of the stakeholders was asked to describe their key concerns (in other words, "what brings you to this meeting?"). The complete list of stakeholder concerns is listed below:

- Aesthetics
- Best management practices
- Clean water
- Cost ("bang-for-the-buck")
- Education
- Fish habitat
- Fishing/shellfishing
- Infrastructure improvements/maintenance
- Managed growth/development
- Meet regulations
- Minimize pollutants
- Nitrogen reduction (point versus nonpoint sources)
- Public health
- Recreation/boating
- Risk management
- Source reduction
- Storm events/system capacity
- System reliability
- Wildlife protection

Stakeholder Issues and Votes

Six small stakeholder groups were asked to review and edit as necessary a shortlist of issues. Then each stakeholder was asked to review all of the issues and vote for his or her top three issues. Their issues and voting is presented below. Note: (#, #%) denotes the number of stakeholder votes and the percent of the total votes.

System Performance Goals:

- Optimize performance of existing facilities including treatment plant capacity (4, 9%)
- Maximize conveyance (2, 4%)
- Eliminate dry weather overflows (1, 2%)
- Evaluate roof leader disconnection (1, 2%)
- Monitor/reduce sediment deposition

- Reduce cave-in potential
- Analyze existing facilities/rehabilitation

Regulatory Goals:

- Comply with EPA and CTDEP CSO Control Policy (3, 6%)
- Meet NPDES Permit Requirements (1, 2%)
- Meet state water quality standards

Receiving Water Goals:

- Focus on improving water quality in critical areas (8, 17%)
- Focus on improving water quality for specific uses like shellfishing, fishing, swimming, boating, recreational uses, wildlife, wetland (tidal, inland) (8, 17%)
- Identify critical water quality areas
- Review economic value of goals
- Meet CTDEP goals

Cost Goals:

- Balance costs and benefits (4, 9%)
- Optimize associated public improvements (2, 4%)
- Optimize associated habitats, water quality improvements, park improvements (2, 4%)
- Reduce program cost
- Affordable and supportable

Public Involvement/Acceptance Goals:

- Arrange for public meeting (by neighborhoods)
- Include target input from users of receiving waters (fisherman, swimmers, etc.)
- Assess the public view (complaints to aldermen, neighborhood management groups, City departments, media, etc.)
- Involve Mayor's public relations staff
- Educate public of fundamental benefits of project

Other Goals:

- Improve aquatic habitat (4, 9%)
- Increase enforcement of existing regulations (zoning, SESC, land use, flood, etc.) (3, 6%)
- Clean streets (2, 4%)
- Improve human quality of life (public values) (1, 2%)
- Public education program (1, 2%)
- Identify long-term economic spin-off benefits (both use and nonuse values)
- Relate these goals to those of the Long Island Sound Study
- Increase source reduction

City Of New Haven Long-Term Control Plan - Stakeholder Input Form

Project Concerns (make any additions/changes):

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Project Goals (make any additions/changes):

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Additional Comments (includes local input, research, available water quality data):

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Meeting Issues (includes suggestions or concerns regarding stakeholder meetings, time, format, participants, etc.)

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PLEASE RETURN THIS FORM TO BRYAN COTE, PERCIVAL COMMUNICATIONS, P.O. BOX 1302, AVON, CT. 06001
OR FAX TO 860-677-5078. THANK YOU.

City of New Haven Long-Term Control Plan – 9/17/98 Meeting Attendee List

** Denotes stakeholder*

NAME	AFFILIATION	COMMENTS
Mark Tedesco*	US EPA Long Island Sound	General interest
Larry Smith*	City of New Haven Engineering	City's Project Manager
Joy Ford*	City of New Haven City Planning Department	City Plan Commission Staff; Inland wetlands commission staff; New Haven designate to Long Island Sound Assembly
Curt Johnson*	CT Fund for Environment	Water quality, stormwater quality, in particular parameters related to human use and health
Sigrund Gadwa*	Quinnipiac River Watershed Association Habitat Work Group QRWP	Water quality in Quinnipiac for recreation / fisheries/ habitat purposes
David D. Reher*	Friends of West River Memorial Park	Water quality in general, West River, specifically
Roy Schiff	Yale University Center for Coastal and Watershed Systems	NPS, water quality, biota
Edward Grant*	City of New Haven Environmental Council	Beaver Pond
Bill Hogan*	CT DEP, Water Management	Compliance with both state and EPA CSO policies; funding
Penny Howell*	CT DEP Fisheries	
Paul Kowalski*	New Haven Health Department	General interest
Emly McDiarmid*	Yale University FES, Center for Coastal and Watershed Systems	Overall watershed environmental quality
Lewis Madley	New Haven Health Department Bureau of Labs	Water quality

Peter Davis*	New Haven Riverkeeper	Water quality; recreation
Jackie Pernell	CT DEP, Environmental Equity Program	CSO in urban areas
Richard Fasano*	New Haven Parks Department	
Navis Bermudez	Yale University FES	General community interest
Heather Langford	Yale University FES	General community interest
John Hudak	S. Central CT Regional Water Authority	Status of past or existing CSOs on Mill River
Richard Cleary	City of New Haven Department of Engineering	Technical Backup
Dick Miller*	City of New Haven, City Engineer	
Bangalore P. Neelakantiah	United International Corporation	Ranking of CSOs, sub-consultant
Ray Smedberg*	New Haven Water Pollution Control Authority	
Edith Pestana	CT DEP, Environmental Equity Program	Prioritizing the CSO plan, to areas that are used for recreation
Peter von Zweck	CH2M HILL	
Dave Burna	CH2M HILL	
Rita Fordiani	CH2M HILL	
Bryan Cote	Percival Communications	

New Haven CSO LTCP Stakeholder List

Organization	First Name	Surname	Attended 9/17/98 Meeting
City of New Haven / Board of Aldermen	David	Moakley	N
City of New Haven / Engineering Department	Richard	Miller	Y
City of New Haven / Engineering Department	Larry	Smith	Y
City of New Haven / Environmental Advisory Council	Ed	Grant	Y
City of New Haven / Health Department	William	Quinn	Y-Paul Kowalski
City of New Haven / Parks Department	Pam	Kressmann	Y-Richard Fasano
City of New Haven / Parks Department	Peter	Davis	Y
City of New Haven / Planning Department	Joy	Ford	Y
City of New Haven / Water Pollution Control Authority	Raymond	Smedberg	Y
City of New Haven, 16th Ward	Raul	Avila	N
CT DEP Bureau of Water Management / Municipal Facilities	William	Hogan	Y
CT DEP Long Island Sound Program	Susan	Gradante	N
CT DEP Marine Fisheries	Ernie	Beckwith	Y-Penny Howell
CT DPHS Bureau of Aquaculture	John	Volk	N
CT Fund for the Environment	Donald	Strait	Y-Curt Johnson
Long Island Sound Keepers Fund / CT Aquaculture Association	Terry	Backer	N
Natural Resources Defense Council	Peter	Lehner	N
Quinnipiac River Watershed Association	Sigrund	Gadwa	Y
US EPA / Long Island Sound	Mark	Tedesco	Y
US EPA-Region 1	Michael	Fedak	N
West River Watershed Association	Duncan	Schmitt	N
Yale University / Center for Coastal and Watershed Systems	Emly	McDiarmid	Y

New Haven CSO LTCP - Additional Meeting Attendees

City of New Haven / Engineering Department	Richard	Cleary	Y
City of New Haven / Health Department Bureau of Labs	Lewis	Madley	Y
CT DEP, Environmental Equity Program	Jackie	Pernell	Y
CT DEP, Environmental Equity Program	Edith	Pestana	Y
Friends of West River Memorial Park	David	Reher	Y
South Central Connecticut Regional Water Authority	John	Hudak	Y
United International Coorporation	Bangalore	Neelakantiah	Y
Yale University FES	Navis	Bermudez	Y
Yale University FES	Heather	Langford	Y
Yale University / Center for Coastal and Watershed Systems	Roy	Schiff	Y

New Haven Long-Term Combined Sewer Overflow Control Plan - Stakeholder Meeting #2 Minutes

ATTENDEES:

Peter Davis/New Haven Riverkeeper

Joy Ford/City of New Haven Planning Department

Edward Grant/City of New Haven Environmental Council

Bill Hogan/CT DEP, Water Management

Paul Kowalski/New Haven Health Department

Heather Langford/Yale University, School of Forestry and Environmental Studies (FES)

Lewis Madley/New Haven Health Department Bureau of Labs

Emly McDiarmid/Yale University, FES, Center for Coastal and Watershed Systems

Dick Miller/City of New Haven, City Engineer

David D. Reher/Friends of West River Memorial Park

Roy Schiff/Yale University Center for Coastal and Watershed Systems

Duncan Schmitt/West River Watershed Association

Larry Smith/City of New Haven Engineering Department

Walter Sinnott/CT DEP, Water Management

Ray Smedberg/New Haven Water Pollution Control Authority

Mark Tedesco/US EPA Long Island Sound

Tracy Triplett/Yale University, FES

Peter von Zweck/CH2M HILL

Dave Burna/CH2M HILL

Rita Fordiani/CH2M HILL

Bryan Cote/Percival Communications

FROM: Rita Fordiani/CH2M HILL

CC: Mike Kuczkowski/City of New Haven Public Information Director

DATE: October 26, 1998

The second stakeholder meeting for the City of New Haven Combined Sewer Overflow (CSO) Control Project was held on Tuesday, October 13th from 4:00 to 6:30 PM in the Public Hearing Room at 200 Orange Street in New Haven, CT. The purpose of the meeting was to solicit stakeholder input regarding evaluation criteria and prioritizing of criteria to be used in the CSO control technology evaluation model. Rather than repeat the material in the presentation, these minutes will present meeting highlights, stakeholder input, record outstanding (parking lot) issues, and provide revised meeting handouts as necessary. For those stakeholder representatives who were unable to attend the meeting, a copy of the meeting presentation handouts (including revisions per meeting input) is included with this packet. Please understand that your participation is critical to this process. If you cannot attend a meeting, please send a delegate.

Meeting Highlights

Response to Questions from September Stakeholder Meeting

At the first stakeholder meeting in September, four issues were raised that were to be discussed at the October meeting. These issues included the following questions followed by responses:

1. *What is the frequency of storm events that increases wastewater treatment plant flows a) above the plant's secondary capacity and b) above the plant's primary capacity?*

   Thirteen months (or about 390 days) of treatment plant data were reviewed. The plant can accept as much as 100 million gallons per day (MGD) through preliminary and primary treatment and chlorination and as much as 60 MGD through secondary treatment, as shown in the handout schematic. This means that *all* flows reaching the treatment plant receive as a minimum preliminary treatment, primary treatment, and chlorination. During the 390 days, there were 41 instances when flows exceeded 60 MGD and were diverted around the secondary treatment facilities. The average volume of the diversion is 2.8 MG per occurrence. The remainder of the inflow received full treatment (preliminary, primary, and secondary plus chlorination). The diverted flows received preliminary and primary treatment and were then blended with the secondary effluent and chlorinated. The diversion is typically used to treat high flows to the plant that result from rain, snow melt, high tides, or illegal hydrant openings. In some cases, the diversion has been utilized to ensure treatment during the plant 's ongoing construction activities. Once the sewer system computer model is calibrated, predictions of high flows to the treatment plant based on precipitation can be analyzed.

2. *What are the volume, frequency, and duration of New Haven's CSOs?*

   Results of the project's monitoring data were presented (see handout materials for data and location map). The results clearly indicated the CSOs with the greatest frequency and volume of overflow include the following: Legion Avenue @ ET Grasso Boulevard; James Street Siphon; Orange Avenue @ ET Grasso Boulevard; Boulevard Pump Station; and the East Street Pump Station. Overflows less than 0.5 million gallons were not included in the monitoring results because meters can be influenced by tidal inflow or splashes that are not accurately representative of an overflow occurrence. Although the sewer system computer model is not yet fully calibrated, preliminary model results compare favorably with the monitoring data with the exception of the CSO at I-91 and Humphrey; this overflow was not monitored because the drainage area tributary to this CSO is presently being separated thereby eliminating CSO from this area. Also, the modeling data indicates overflow from other CSOs not shown on the monitoring results; this is because larger precipitation events were used in the model than occurred during the monitoring period to show the *potential* for CSOs around the city. Once the model is calibrated, more complete CSO statistics will be developed.

3. *Include private beaches and other swimming areas on project area map (Figure 1).*

   Several trips were made and discussions held with stakeholders throughout the project area to verify documented uses and identify undocumented uses of the receiving waters. Some edits were made at the October stakeholder meeting. A revised Figure 1 to include those edits is attached to these minutes; this revised Figure 1 replaces the Figure

1 presently in your stakeholder binders. Other highlights of the trip include the observation of no dry weather overflows occurring from New Haven CSOs and that fishing and fish consumption is a widespread occurrence throughout the receiving waters. An illegal discharge of white paint to the West River from a New Haven stormwater outfall was also observed; the notified authorities quickly responded and corrective action is taking place. There was discussion citing the essential need for public education. Suggestions included encouragement of public education in both the West and Quinnipiac River Initiatives and clarifying and publicizing the procedures for who you call if a suspicious discharge is observed.

4. *Present available water quality information for project area.*

   Available water quality data is being reviewed for the project area (this includes treatment plant data, CSO data from the *1981 New Haven Sewage Collection System Facility Plan*, stormwater data reported to the Connecticut Department of Environmental Protection from 1996 to 1998 by industrial dischargers as part of the general stormwater permit requirements, and receiving water quality data compiled from several sources: United States Geological Survey, the *1996 State of Connecticut Bureau of Aquaculture Annual Assessment of All Shellfish Growing Waters in New Haven* covering 1994-1996, the *1991 CTDEP Quinnipiac River Survey*, *1990 New Haven Water Quality Survey* by Metcalf and Eddy, and the *1974 CTDEP New Haven Harbor Intensive Water Quality Survey)*. CH2M HILL data has been shared with Yale University, stormwater data has been received from Yale, and we are still waiting to receive receiving water quality data from Yale. The City of New Haven Planning Department has recently hired a biologist to collect water quality data in Beaver Pond; this data, if available, will also be pursued. We hope to complete our analysis of the available data by the end of October.

CSO Control Technology Evaluation Model Development

After discussion of the above topics, the meeting progressed with a review of project issues, considerations in CSO control technology selection, and elements of the CSO control technology evaluation model. The following elements were added to the evaluation model:

- Under the category of System Performance: *Eliminate wet weather overflows (CSOs)*
- Under the category of Public Acceptance: *Minimize time for improvements*
- Under the category of Community Impacts: *Eliminate sewer backups*

There was some discussion about the definition of critical areas; this discussion will resume after the preliminary screening of CSO control technologies to assist in the further evaluation, selection, and implementation of CSO controls.

Stakeholders were then asked to prioritize the elements in the evaluation model, scoring elements with values ranging from zero for least important to 100 for most important and understanding that more than one element can receive the same score (i.e., several elements can receive a score of 100, for example). Fourteen stakeholders were present for the scoring; their scores were entered at the meeting and the results were discussed to check if anyone wished to change their scores. It was noted that one of the original drivers for the prioritization of which sewers were to be separated under the on-going sewer separation program was to prevent sewer backups in people's basements. Some stakeholder scored this high because of the extreme public health issue; other stakeholder scored this low because they believe that is a given responsibility of the City's that should not detract from the goals of this program. It was also noted that public education was not reflected in the scoring and, therefore, will need to be addressed under other programs. All stakeholders stayed with their original scores. In summary, the results indicated that the top priorities included meeting water quality standards, protecting critical areas, and eliminating both dry and wet weather CSOs. The detailed results are attached. The meeting concluded that this project has funding and objectives to meet and unfortunately cannot meet all the hopes of the stakeholder group; however, that does not mean the hopes are not valid or important nor does it mean that other programs do not need improvements. This project is essentially a starting point to regional water quality improvement.

As the meeting was extending beyond the scheduled time, we did not go over the Strategy Table handout as a group. Stakeholders may review the Strategy Table to link items under the different categories to see how strategies can be applied.

The next meeting will be a public meeting scheduled for Tuesday, either December 1st or 8th, from 6:30 to 7:30 PM, in the Public Hearing Room at 200 Orange Street, New Haven (details to be announced when confirmed) to review the CSO control technology preliminary screening results of the evaluation model.

Next Steps

The project team is presently reviewing CSO control technologies to assign values for how well a particular technology performs relative to each element in the evaluation model. These values and the priority values provided by the stakeholder at the October 13th meeting will be reviewed at the public meeting along with the CSO control preliminary screening results using the evaluation model. The next meeting is scheduled for Tuesday, either December 1st or 8th, from 6:30 to 7:30 PM, in the Public Hearing Room at 200 Orange Street, New Haven (details to be announced when confirmed).

Parking Lot

The "parking lot" is the meeting board to "park" unanswered meeting questions. One question was received after the meeting: What is the acreage of drainage area tributary to each receiving water within New Haven as compared to the acreage of tributary drainage area outside of New Haven? The intent of the project team is to provide a response at the next meeting.

Upcoming Meetings

- The first public meeting will be held Tuesday, either December 1st or 8th, from 6:30 to 7:30 PM in the Public Hearing Room at 200 Orange Street, New Haven. Meeting details to be announced once confirmed. A 1-hour presentation of the stakeholder process and evaluation model results will be presented. Refreshments will be served. Please *RSVP* to Bryan Cote at Percival Communications: phone (860) 677-5076; fax (860) 677-5078; email perccomm@aol.com.
- An alternatives evaluation workshop will be held in early 1999 to further refine the CSO control technology evaluation, selection, and implementation.

Communication

Please do not hesitate to contact the following project staff:

Regarding logistical information:

Bryan Cote
Percival Communications
P.O. Box 1302
Avon, CT 06001
Phone: (860) 677-5076
Fax: (860) 677-5078
Email: brycote@aol.com

Regarding technical information:

Rita Fordiani
CH2M HILL
50 Staniford Street
Boston, MA 02114
Phone (617) 523-2260 x210
Fax: (617) 723-9036
Email: rfordian@ch2m.com

City Of New Haven Long-Term Control Plan - Stakeholder Communications Form

Project Concerns (make any additions/changes):

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Additional Comments (includes local input, research, available water quality data):

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Meeting Issues (includes suggestions or concerns regarding stakeholder meetings, time, format, participants, etc.)

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PLEASE RETURN THIS FORM TO BRYAN COTE, PERCIVAL COMMUNICATIONS, P.O. BOX 1302, AVON, CT, 06001
OR FAX TO 860-677-5078. THANK YOU.

New Haven CSO Control Prioritization Mean Values — CRITERIA

(0-100 scale; max. = 100)

		Round 1	Rank	
Water Quality	Meets State WQ standards (bacteria, DO)	88	1	
Water Quality	Minimize solids	66	14	
Water Quality	Minimize floatables	68	13	
Water Quality	Minimize metals	65	15	
Water Quality	Minimize nutrients	70	10	
System Performance	Maximize conveyance	75	6	
System Performance	Maximize treatment plant capacity	73	7	
System Performance	Eliminate dry weather overflows	81	3	
System Performance	Eliminate wet weather overflows (CSOs)	81	3	
Public Acceptance	Maximize recreational use	72	9	
Public Acceptance	Maximize aquatic habitat	76	5	
Public Acceptance	Minimize public complaints	56	19	
Public Acceptance	Minimize time for improvements	69	11	
Cost	Minimize capital costs	62	16	
Cost	Minimize O&M costs	59	17	
Environmental Impacts	Protect wildlife	73	7	
Environmental Impacts	Protect critical areas	86	2	
Community impacts	Clean streets	52	19	
Community impacts	Maximize associated public improvements	37	20	
Community impacts	Maximize local park improvements	54	18	
Community impacts	Eliminate sewer backups	69	11	

New Haven Long-Term Combined Sewer Overflow Control Plan - Public Meeting #1 Minutes

ATTENDEES:

General Public:

Shimon Anisfeld

Frank Cochran

Lee Cruz

Henry Dynia

Helene Kasha

Jerry Loiselle

John Sawyer

Pam Stanton

Susan Swenson

Stakeholders:

Peter Davis/New Haven Riverkeeper

Sigrund Gadwa/Quinnipiac River Watershed Association

Edward Grant/City of New Haven Environmental Council

Curt Johnson/CT Fund for the Environment

Lewis Madley/New Haven Health Department Bureau of Labs

Emly McDiarmid/Yale University, FES, Center for Coastal and Watershed Systems

Dick Miller/City of New Haven, City Engineer

Dave Moakley/Board of Alderman

David D. Reher/Friends of West River Memorial Park

Duncan Schmitt/West River Watershed Association

Larry Smith/City of New Haven Engineering Department

Walter Sinnott/CT DEP, Water Management

Ray Smedberg/New Haven Water Pollution Control Authority

Mark Tedesco/US EPA Long Island Sound

Project Team:

Peter von Zweck/CH2M HILL

Cliff Bowers/CH2M HILL

Rita Fordiani/CH2M HILL

FROM: Rita Fordiani/CH2M HILL

CC: Mike Kuczkowski/City of New Haven Public Information Director

DATE: December 18, 1998

The first public meeting for the City of New Haven Combined Sewer Overflow (CSO) Control Project was held on Tuesday, December 8, 1998, beginning at 6:00 PM and concluding at approximately 8:00 PM City Hall, Meeting Room #1, 165 Church Street, New Haven, CT. The purpose of the meeting was to: 1) educate the public on the status and process of CSO control planning and implementation and 2) to solicit feedback for the current planning process. A copy of the meeting presentation (is available upon request) and "*Summary*" handout is

CSO Solutions

CSO control technologies can typically be discussed as five categories:

- Sewer system optimization – adjust the conveyance system to allow it to pass greater flow on to the wastewater treatment facility
- Pollutant source controls – remove pollutants from the sewer system to reduce pollutants in the wastewater and CSOs
- Stormwater inflow reduction – prevent stormwater from entering the combined sewer system to reduce/eliminate CSOs
- Treatment – treat CSO before it reaches the surface waters to reduce pollution
- Storage – store combined sewage underground during rainstorms and release it to the wastewater treatment facility as capacity becomes available

A variety of CSO control technologies were evaluated using the decision model developed with stakeholder input as previously described. The results of the model indicated that the technologies that best meet the objectives of the stakeholder group include:

- Upland stormwater storage
- Below ground CSO storage
- Treatment plant modifications

Next Steps

The next steps include grouping several technologies together for additional evaluation and examining which technologies can be applied in the various tributary areas. Alternatives will be developed and modeled to predict sewer system impacts and CSO reduction results. Preliminary designs, cost and benefits will be determined and reviewed with the stakeholder group in the spring of 1999. At this time it is anticipated that a second public meeting will be held during the summer of 1999.

Questions & Answers

Q1 – Has there been any consideration for using New Haven's sandy soils for infiltration of stormwater such as creating isolated dry wells?

A1 - Contamination of groundwater is an issue. Runoff occurs very rapidly. Runoff from small areas can be captured in drywells for infiltration into the soils. However for large areas this becomes impractical.

Q2 – Do overflows occur during dry weather?

A2 – Dry weather overflows are not frequent as they typically occur as a result of mechanical difficulties

Q9 – Are there plans to repair Mill River gates?

A9 – Not familiar with operational problems. Needs investigating. Sometimes debris does get caught up in the gates, preventing them from sealing properly and allowing water to pass. The tide gates were originally put in for mosquito control.

Q10 – If CSOs are eliminated but stormwater pollution remains, then how will this be addressed?

A10 – Will address in this program.

Q11 – CSO treated at the wastewater treatment facility receives primary treatment, not secondary, correct? This needs to be included in the evaluation of alternatives and the model.

A11 – The treatment plant can accept as much as 100 million gallons per day (MGD) through preliminary and primary treatment and chlorination and as much as 60 MGD through secondary treatment. Any flows above the capacity of secondary treatment receive preliminary treatment and primary treatment are then blended with the secondary effluent and chlorinated. The treatment plant provides some degree of treatment to *all* flows it receives, which is much better than no treatment at individual CSO discharge locations.

Q12 – CSO #024 is near major development areas – this needs to be considered during planning.

A12 – Yes, we have a sewer system hydraulic model to evaluate CSO impacts and creative/cost effective solutions.

Q13 – Water quality problems in New Haven focus on bacteria and dissolved oxygen. Are we going to show benefits to all pollutants?

A13 – The evaluation criteria developed by the stakeholders include several pollutants used in the analysis. Reduction of these same pollutants will be reviewed throughout the study.

Q14 – Will there be an executive summary of the evaluation process?

A14 – Yes, a technical memorandum will be prepared and available for review. The memorandum is not expected to be very lengthy and will most likely be distributed to all stakeholders.

Q15 – Can information be posted to the City of New Haven's website?

A15 – Yes; for example, all of the project newsletters are on the website.

Q23 – City not educating public on stormwater controls. Need a program similar to the recycling brochures to describe building dry wells and roof leader disconnections.

Dick – Good point.

SUMMARY: NEW HAVEN'S COMBINED SEWER OVERFLOW CHALLENGE & PROGRAM

The Background. The extensive sewer system that runs beneath the streets of New Haven was built over many generations in response to the needs of the day. Some of it dates back to the 1800s. In reality, it is three systems in one:

1) A network of stormwater pipes that discharge rainwater into the Mill, West and Quinnipiac Rivers and New Haven Harbor;

2) A pipe system that carries sanitary sewage (wastewater) from homes and businesses to the New Haven Water Pollution Control Authority (WPCA) plant for treatment before discharge into the harbor; and,

3) Pipes that carry a combination of stormwater and wastewater. In periods of little rainfall, this mix flows to the WPCA plant for treatment before its discharge. In periods of heavy rain, these combined sewers, by design, divert excess volume to 21 "outfalls" through which it is discharged, untreated, into the city's waterways. These are called Combined Sewer Overflows, or CSOs.

The Challenge. Much has changed since most of this system was installed. Great strides have been made in scientific knowledge of the adverse effects of inadequately treated wastewater, and to a lesser extent of stormwater, on human and aquatic health. There is a heightened awareness of its negative impact on water-related business, on recreational activity, and on the quality of life enjoyed by residents who live and work near affected waterways.

This has led to diminished public and regulatory tolerance of continuing waterway contamination and to ongoing enactment of more-stringent laws and regulations requiring improved wastewater treatment and better control of CSOs.

Adding to the challenge, new homes and businesses have been built over the years, and on-site septic systems have failed, increasing wastewater volume. Streets and lots have been paved, reducing the earth's capacity to absorb rain and snow-melt, and adding to the flow of stormwater. The result has been increased CSOs, increased discharge of untreated sewage.

The Implications. The City and the WPCA must carry out an extensive and expensive program to upgrade facilities and their control to meet more-stringent government regulations, reduce CSOs and related waterway pollution, and enhance New Haven's attractiveness as a good place to live, to work and to recreate.

The Players. The City and the WPCA have primary responsibility for this effort. They have engaged the engineering firm CH2M Hill to assist in defining the problem, establishing objectives, analyzing alternative technological approaches, setting cost and performance parameters, and developing the specifics of a long-term action plan.

A roster of "stakeholders," constituting representatives of government, environmental, health, educational and business sectors that will be most affected by the outcome of this effort, has been enlisted to actively participate in its planning, decision-making and execution. In a broader sense, all citizens who pay taxes, pay sewer-use charges, live, work or recreate in New Haven have an important stake in this project. They will be given opportunities, and are urged, to participate in the process.

The Status. Initial steps to alleviate CSO problems were taken as far back as 1981 with development of a long-term facility plan, which was updated in 1988. That plan, based on 1980s costs, regulatory requirements and CSO control technology, envisioned separation of storm and sanitary sewers, with no provision for the treatment of stormwater. Today, some 35% of the recommended separation projects have been completed, and the City and WPCA are undertaking a reevaluation based on updated science, regulation, CSO control technology and cost factors.

In April 1997, CH2M Hill was commissioned to prepare a Long-Term CSO Control Plan (LTCP) to comply with U.S. Environmental Protection Agency CSO Control Policy guidance, with provisions of the WPCA's National Pollutant Discharge Elimination System permit as enforced through the Connecticut Department of Environmental Protection, and to reduce the cost of constructing CSO controls.

Now approximately 70% complete, the LTCP project has reached a point at which public input can play an important part in setting the direction for the remainder of the program, which includes evaluation of alternatives, design, and long-term CSO control plan development.

Costs & Consequences. Of the total cost of $120 million previously projected (in since-deflated 1987 dollars) for sewer separation, some $30 million has been expended to date. New projections are yet to be developed, and will depend to some extent upon the choices of technology made. Regardless, it is clear the cost of this undertaking will have substantial consequences to the taxpayers and sewer-use ratepayers of New Haven, as will the resulting benefits of cleaner waterways and environmental, esthetic, recreational and economic improvements.

CSO Program Contacts: City of New Haven Engineering Department
Larry Smith (203) 946-8099

New Haven WPCA
Ray Smedberg (203) 466-5280

CH2M Hill
Rita Fordiani (617) 523-2260, Ext. 210